Editorial

DURING the month, the "atom-bomb" era was brought close to Australia by the explosion which took place at Monte Bello.

It was so close that hailstones which fell in Adelaide showing a double dose of radiation might well have been influenced by it.

It was inevitable, therefore, that many have entertained fears that Australia's isolation, real or fancied, and consequently some measure of her physical safety, might have been prejudiced by the event. Atom-bombs in the abstract are one thing, but quite another when they appear on our front doorstep.

I wonder whether there is any basis for this viewpoint? It may never have arisen if the application of atomic power had first taken place in peace instead of during war. As it was, we might well remember that we were fortunate—there is every evidence that the German V2's were meant to carry atomic warheads. The Americans were the first to succeed while the German plans were prevented from maturing.

The danger period from atomic bombs might well have passed. Unquestionably it was within the power of the USA to have devastated the world during the period when atom-bombs were found in its arsenal alone. Had other powers been first with this weapon, the story might have been a different one.

If we assume now that all the major combatants in a possible new war would be able to blast each other from the earth's surface, might not that fact be the most potent reason not to use atom-bombs, or their more powerful successors? What would anyone gain by entering a conflict the result of which might be victory only in that the devastation of the enemy would be the more complete? That wouldn't rebuild the victor's cities, or render what remained of the world any more practicable to live in.

In other words, we cannot safely depend on anyone's ethics when an all-out war is in progress. But I think we might depend on self interest taking its place if it is a queston of almost certain and complete self-destruction. Such a possibility simply means that war will paradoxically become too dangerous.

I think there are signs today that this might be the case It may be far more likely that if atomic power is used in war, it will be more effective in increasing the speed with which other weapons can be used to win. If wars as such become too dangerous and unprofitable, then nations will find other ways to impose their wills on others.

Whether the ultimate dangers will be greater or not is problematical. All we can hope for at the moment is that at least we will have a better chance of emerging with our lives.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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VOL. 14 No. 8

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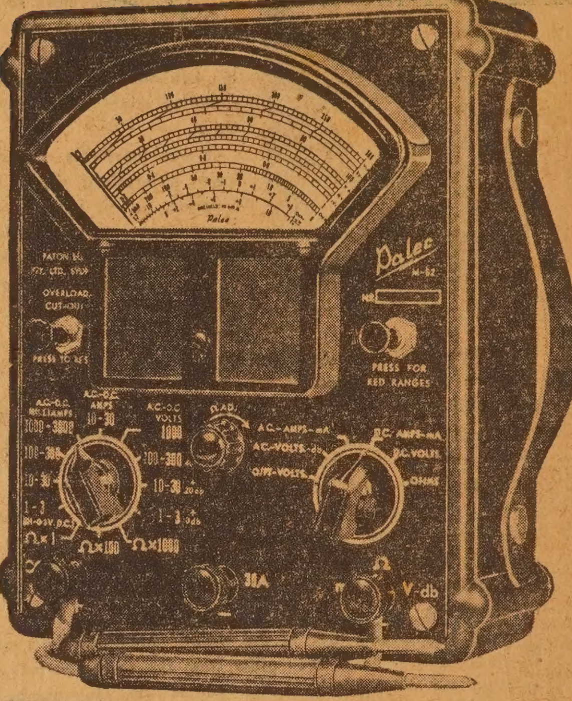

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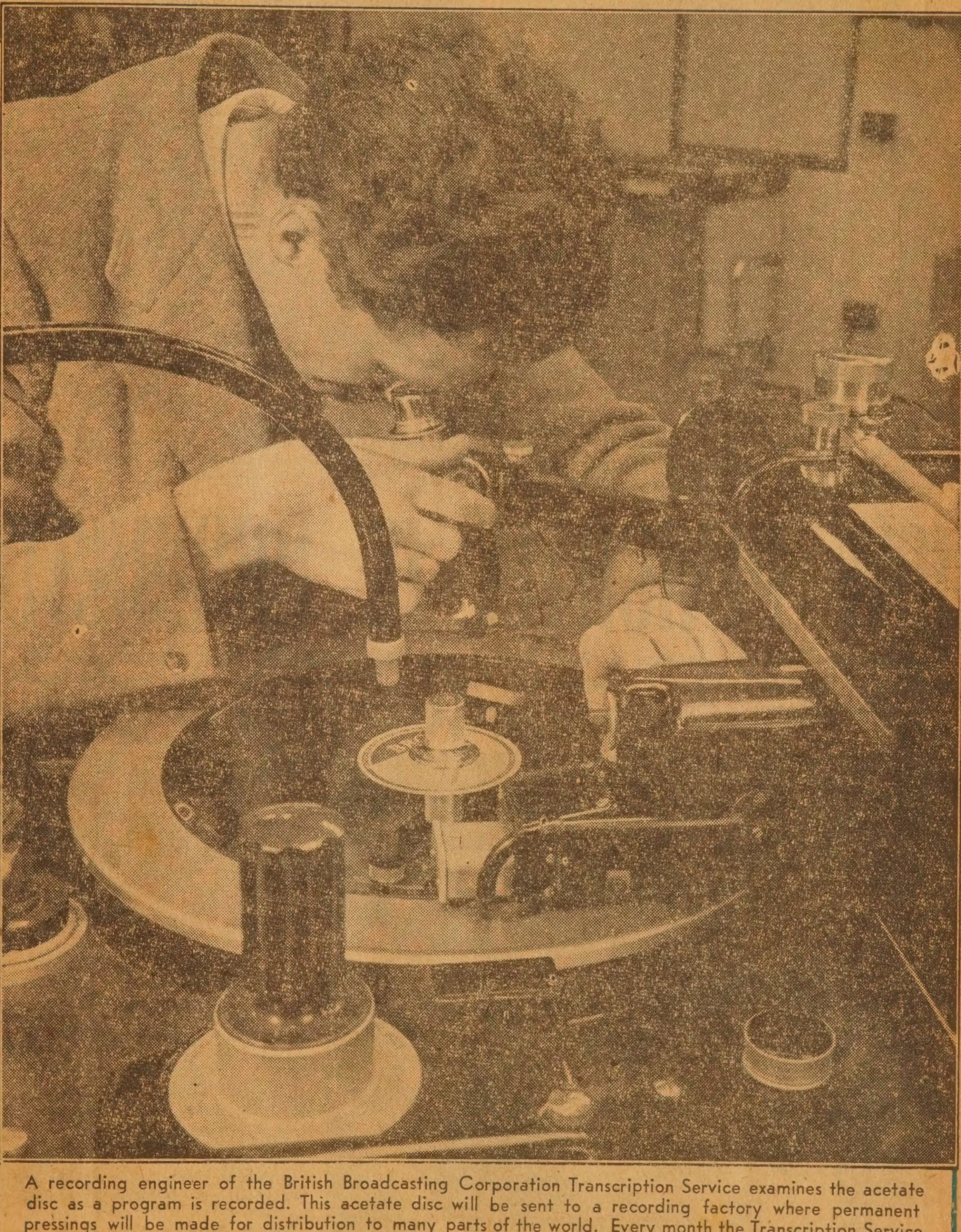
RECORDING A BBC TRANSCRIPTION



A recording engineer of the British Broadcasting Corporation Transcription Service examines the acetate disc as a program is recorded. This acetate disc will be sent to a recording factory where permanent pressings will be made for distribution to many parts of the world. Every month the Transcription Service sends a complete cross-section of the BBC programs to English language radio organisations, and also supplies a certain number of foreign countries with programs in their own languages.

Penicillin, the drug obtained from a mould discovered by Sir Alexander Fleming, and later developed by Sir Howard Florey and other scientists, is today exported from Britain to the rest of the world. The commercial production of penicillin begins in the laboratory. Here is a surface culture of the mould, as seen in the laboratory of a leading firm of manufacturers.

After the surface culture of the mould has been grown on sterile maize, liquid nutrient broth is added to the flask for further growth. This is done in the "Transfer Laboratory" seen here. Note the strict precautions taken by the staff to prevent the mould being infected by bacteria in the air and from their own breath.

HOW PENICILLIN IS PRODUCED

Penicillin, the healing substance derived from a mould and discovered by Professor (now Sir) Alexander Fleming and later developed by a team of British scientists under Professor (now Sir) Howard Florey, is today being manufactured in Britain on a large scale and exported throughout the world.

AMONG leading producers of this substance is The Distillers Company (Biochemicals) Ltd., of Speke, Liverpool. This company's products, including penicillin, streptomycin, and vitamin B 12, are exported all over the world by several of the large drug houses of Great Britain.

There are four main phases in the production of penicillin; growth, recovery, packing and testing. To encourage the mould to produce commercially useful quantities of penicillin as it grows, certain important conditions have to be strictly observed.

The first of these is sterility. Everything that comes into contact with the mould, including the at-

The growth of the mould continues in flasks but, if they were left to stand still, the growth would be confined to the surface of the liquid. Therefore, the flasks are placed in racks and gently shaken continuously. Each flask is labelled and dated. The strengthening of the laboratory culture takes several days and constant tests take place in the laboratories to keep a check on contamination and other possible adverse developments.

mosphere itself, must be kept free from germs, for some of them liberate an enzyme which destroys penicillin. The nutrient material in which it is grown must be carefully selected to give the greatest yield. If it is too acid or too alkaline, no penicillin will be produced.

The temperature of the culture must be strictly controlled; high temperatures reduce the yield of penicillin.

Initially, the mould is grown in the laboratory. Dry mould spores (or "seeds") are made to germinate on damp sterile maize in small flasks. After some growth has taken place, sterile nutrient broth is added to the flasks which are shaken continuously by mechanical means so that, instead of growing only on the surface, the mould grows throughout the whole of the liquid medium.

by H. P. Bellanti

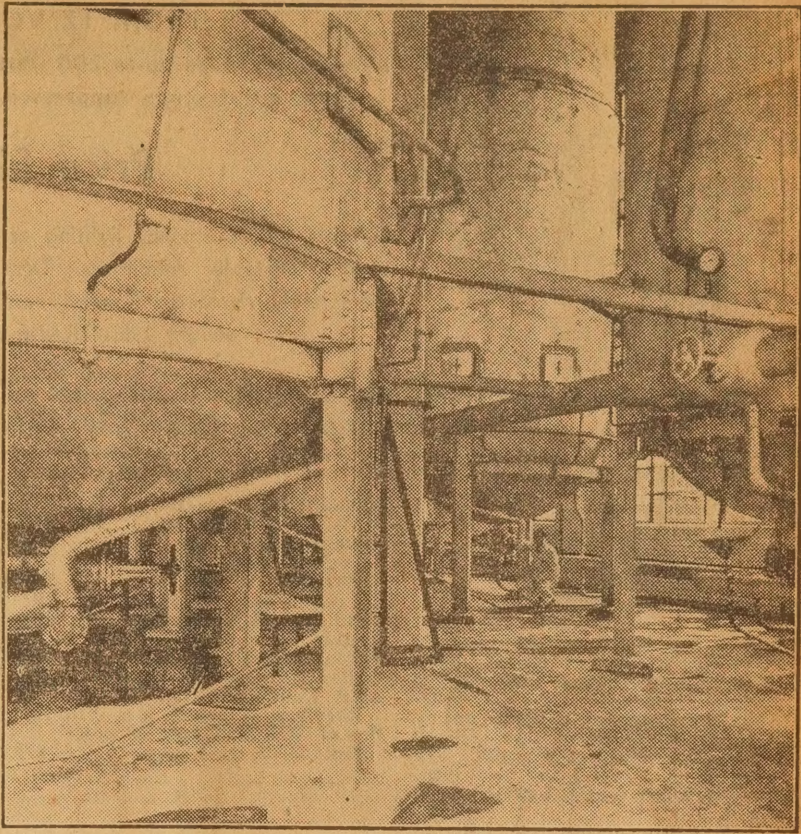
(from London)

This is the beginning of the process of deep fermentation, and is now repeated on a large manufacturing scale. The contents of the flasks are transferred to 500-gallon "seed vessels" in which the mould continues to grow and thence into 10,000-gallon fermenters, where the final stage of growth takes place.

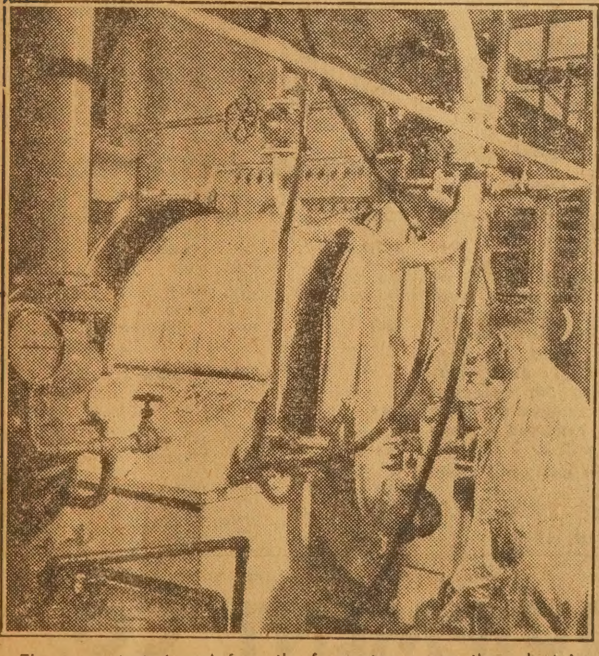
Agitation in the "seed vessels" and fermenters is effected by bubbling sterile air, necessary for growth, through the culture. The nutrient liquid used throughout the process is corn steep liquor, a by-

(Continued on Page 19)

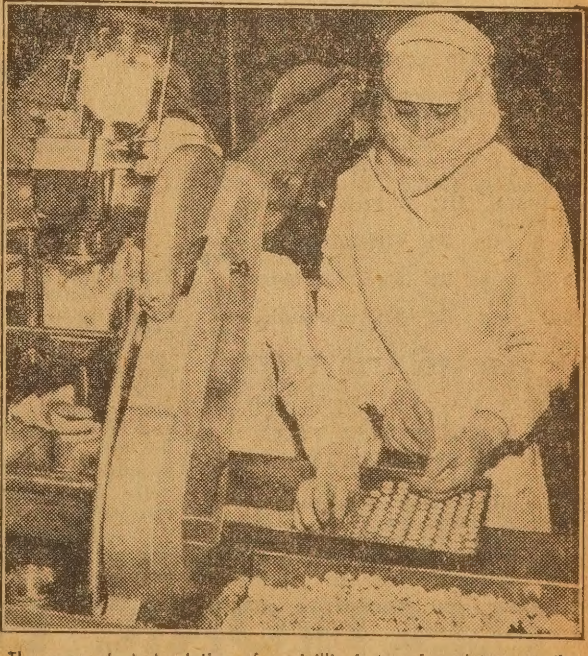
FINAL GROWTH IS IN HUGE TANKS



At the right time, the contents of the flasks are transferred first to 500 gallon tanks called "seed-vessels," where the process of "deep fermentation" continues. Subsequently the liquid is pumped into these huge 10,000 gallon vats, known as "fermenters."



The concentrated mash from the fermenters passes through stainless steel pipes into a rotary vacuum filter which removes the mycelium of the mould as a scummy felt. What is left is a clear broth or "beer" containing penicillin. This is concentrated before being passed into the sterile area.



The concentrated solution of penicillin is transferred into sterile, pressurised rooms for crystallisation. There it is tested, weighed and packed into sterile vials which are then sealed before they leave the sterile section. After sealing, they pass out into a regular packing section for despatch.

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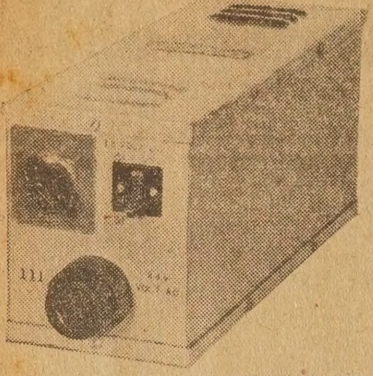

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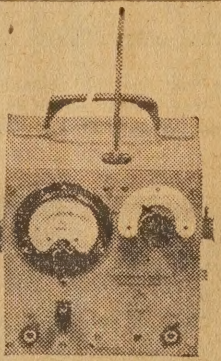

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JET FLYING BOATS PREDICTED

Although only a small majority of airlines now operate flying boats, several of the world's leading aircraft designers are developing new configurations for giant marine airliners far larger than anything now flying.

THEY believe that the next stage of aviation development lies not so much in greater speeds (where the commercial limit has nearly been reached) but in increased size. They envisage machines two or three times the size and weight of the largest British aircraft of today.

As merchant aviation expands particularly in the ever growing field of freight-carriage, they believe there will be an increasing demand for these giant boats which could operate from any of the many trading centres in the world where there are adequate harbor facilities.

A prominent American designer, Ernest G. Stout of Convair, recently reported as advocating that United States constructors should build very large water-based airliners now, in order to overcome Great Britain's present lead in jet transports by being first in the next phase of development.

He claimed that any modern transport could be water-based without loss of performance. "The seaplane jetliner will in fact have many inherent advantages over its landplane counterpart, including superior mobility, increased efficiency and improved safety factors."

However, British designers are already well ahead with practical tests and advanced designs for future flying boats. The Saunders-Roe Princess flying boat, with 10 turboprop engines, the world's largest metal airliner, is the outstanding example of British progress in this field.

HEAVY COMPETITION.

Both the Short and Saunders-Roe companies are heavily committed to research into boat developments. Among their design studies for future flying boats is one driven by six engines of the by-pass or ducted-fan type. These engines are mounted in the tail so that cabin noise can be reduced to a minimum.

In the past five years, designers have made much progress in overcoming the drag or air resistance traditionally held as an obstacle to high performance flying boats. The drag was caused by the shape of the hull necessary for efficient operation from water.

Most conventional boats have had at least one step, half-way back along the hull, to break up the suction caused by the flow of water when the boat is taking off.

Careful research has now shown how a long slender hull with practically no step can be designed to give good water performance. Better streamlining, vital for high speed flight, is therefore possible.

Again, the development of jet powerplants with no propellers enables designers to put their wings in the best position without the fear that spray will be flung up and cause damage, as would have been the case with a propeller engine which was not kept well above the water.

These and other developments now under active study give good promise that huge boats can be built which will have all the high performance characteristics of the landplane, coupled with the flying boats very great mobility.

In connection with auxiliary equipment for airliners of all types, a British radio company is developing an automatic screen map which can be mounted in airliner cabins to show passengers exactly where their plane is at any moment from take-off to touchdown.

The screen, which measures 21in x 16in, is fitted with a series of transparent screen maps. A dot of light moves across the map showing exactly the true position of the aircraft. The light is controlled from the automatic Decca Navigator mounted in the pilot's flight deck.

The Decca Navigator, the "master" unit, is an automatic airborne version of the equipment already used at sea by well over 1000 ships. It is a radio brain which picks up signals from the same ground stations as those used at sea.

It automatically locates the aircraft in the space patterns sent out from these chains of ground stations, and so works quite independently of atmospheric conditions like wind.

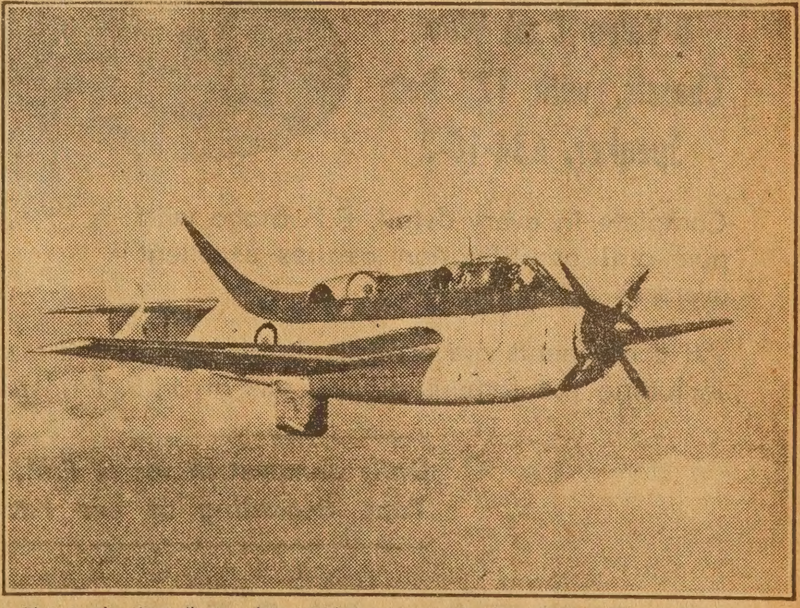
Unlike the passenger cabin repeater, the pilot's Navigator is a strip map on rollers. As the airliner flies through the air, so the map unrolls, and the pilot watches a stylus pen move across it, tracing in the path of the aircraft over the ground.

Use of the Navigator is growing as more and more ground stations are built, spreading their signals over more and more of the world's surface. Chains are now working in Britain, Scandinavia, and Germany and are being constructed in France and other parts of Europe.

The passenger cabin screen is still under developmnt and is not yet in production. But the pilot's "master" unit has already been adopted by British European Airways for its fleet.

It will go into service first on the Viscount turbo-prop and has already been extensively air-tested on airliners and helicopters. By next year it will be widely used in flights over Europe.

LATEST ANTI-SUB AIRCRAFT FOR R.N.



This is the first flying photograph of the production type Fairey GANNET, the Royal Navy's only super priority aircraft. The Gannet—shown here with two small additional tail fins—is a three seat carrier based anti-submarine aircraft powered by an Armstrong Siddeley Double Mamba twin propellor turbine engine. Features of the design are double fold wings, to facilitate stowage aboard ship, radar scanner aft of the long bomb bay, and the position of the pilot's cockpit, which ensures excellent forward and downward vision for patrol and deck operation. The aircraft has a span of 54ft 4in and is 43ft long, but no performance figures are yet released.

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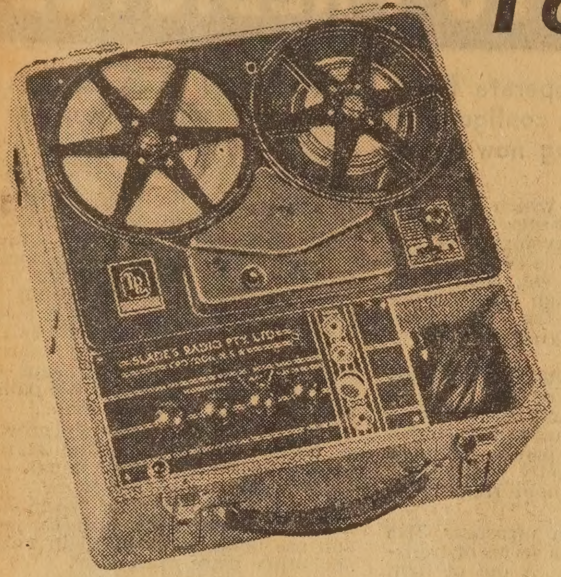

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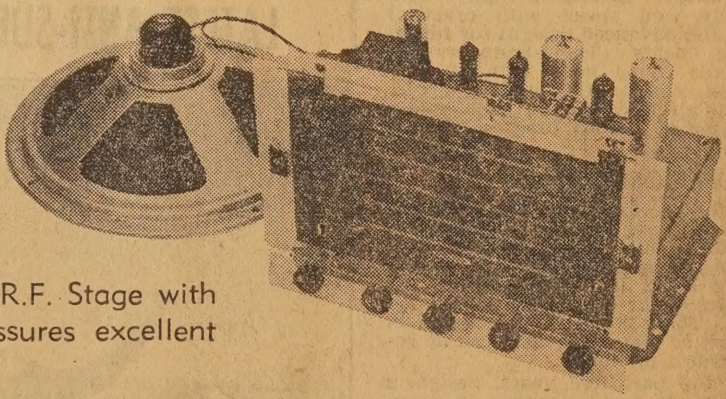

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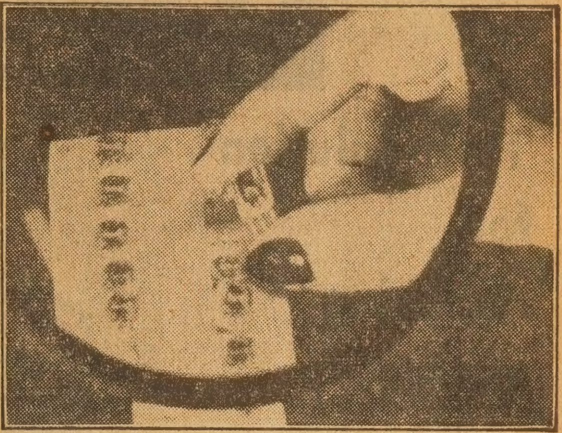


☆

Seen under a magifying glass — a point contact resistor developed by RCA scientists. The small size of transistors, coupled with their current economy and now an extension into the VHF region, makes their general use certain, once the mass production stage has been reached.

SEVERAL developmental point-contact transistors have been made to oscillate at frequencies well up in the 100-200 megacycle band and one reached a record high frequency of 225 megacycles per second, according to Dr. Charles B. Joliffe, Vice President and Technical Director of RCA.

Such frequencies include the range in which FM radio and television signals are broadcast. The highest frequency value previously achieved by transistors, according to published reports, has been 50 megacycles per second.

SMALL SIZE

The transistor, still in the developmental stage, consists of a speck of germanium crystal and fine contact wires and is no greater in size than a kernel of corn. It can perform many of the functions of electron tubes.

Prior to recent RCA experiments, transistors have been regarded as limited to relatively low-frequency applications, Dr. Jolliffe said.

The new development promises to extend the use of the tiny transistors in high-frequency devices and to new applications in television, FM radio, point-to-point radio communication and other electronic equipment for military and civilian use.

The successful development of transistors which oscillate in the very-high-frequency region was accomplished by B. N. Slade, transistor engineer of the RCA Tube Department, RCA Victor Division, Harrison, NJ.

This experimental work was conducted as a phase of RCA's transistor research program which is co-ordinated at the David Sarnoff Research Centre of RCA, Princeton, NJ.

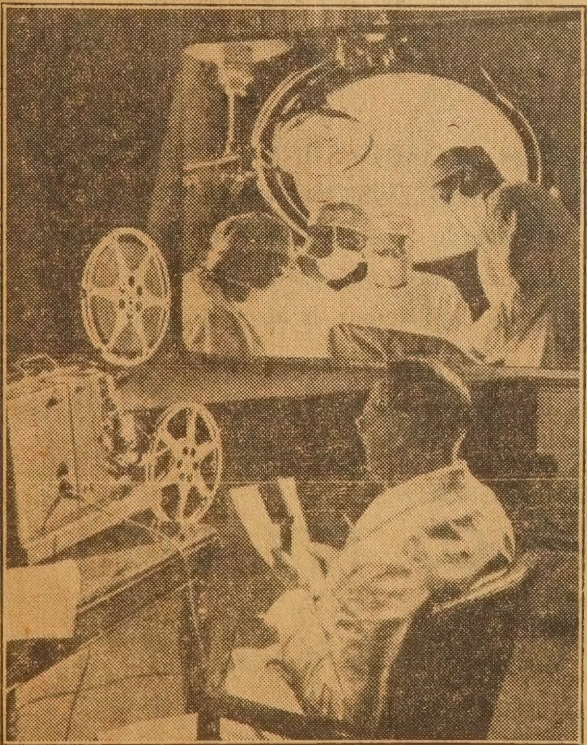
Mr. Slade pointed out that the research theory which led to the development of VHF transistors now makes possible the design of transsistors which incorporate particular operating characteristics for a given application.

Tests conducted at the RCA Tube Department's Harrison, NJ, transistor laboratories confirmed a definite correlation between the spacing of a transistor's contact points and its frequency response. Generally speaking, Mr. Slade said, the closer the spacing, the higher the frequency.

Further tests established that a transistor's frequency response and stability are also determined to a large degree by the resistivity of its germanium crystal.

RCA transistor engineers, he explained, developed different combinations of spacing and resistivity values which enable them to design experimental transistors having a range of operational characteristics. One such combination of values also resulted in a transistor which oscillated with good stability at a frequency of 225 megacycles per second.

MAGNETIC SOUND FOR 16 mm FILMS



A commentator, using RCA's newest 16mm. sound projector records his voice to accompany a film on surgical training. The voice is recorded on a magnetic coating on the edge of the film which normally carries the optical sound track. The recording, playback and erase facilities are exactly the same as for a regular tape recorder. Magnetic recording would appear to offer chances of better fidelity on substandard films than optical recording. Tape recorders are now being made to operate at speeds as low as 1-7/8 inches per second.

NEW WINDOW GLASS

A NEW heat-absorbing plate glass for windows which will exclude 61 pc of the total sun radiation but transmit 71 pc of average daylight is announced by an American glass company.

A combination of two pieces of glass with an air sealed space between will exclude 78 pc of the solar radiation and transmit 62 pc of the light.

Heat-absorbing glass of various types is already in use but the new type is claimed to be superior in the ration of light to heat trasmitter.

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RELEASE OF PRE-RECORDED TAPES

The first full-range recorded tapes for commercial sale featuring major orchestras with noted conductors and soloists will be introduced by MaVoTape, Incorporated, at the October-November Auido Fair in New York City. Distribution of the recordings, to be sold as "Magnecordings by Vox," will follow the New York introduction.

THE "Magnecordings" will be recorded on half tracks of standard recording tape at 7½ inches per second tape speed, presenting a full hour program on a professional 7in reel. Special equalisation in recording will give high fidelity reproduction of 15,000 cycles.

The "Magnecordings" will be made by Magnecord, the world's oldest and largest manufacturer of professional magnetic tape recording equipment for MaVoTape, Inc., from the "master" tapes of the Vox Productions, Inc., library, and will be distributed initially through Magnecord distributors. "Magnecordings by Vox" will offer all the advantages of tape recording, no surface noise, no loss of quality through wear, and the accurate liveness and range of full frequency reproduction, 50 to 15,000 cycles.

INITIAL RELEASE

"Magnecordings" will be sold by "time segments"; the length of the selection will determine the price of the tape. An hour program, 7in reel of 1200 feet (2400 feet of recorded program) will sell for 9.95 dollars.

Plans call for six releases per month. Initial releases will include Shostakovich — Fifth Symphony by the Vienna Symphony Orchestra, Jascha Horenstein conductor; Mahler—Symphony No. 2 in C Minor, The Resurrection, by the Vienna Symphony Orchestra, Otto Klemperer, conductor with Ilona Steingruber, soprano; and, Tchaikovsky—Piano Concerto in B Flat by Monique de la Brouchollerie and the Vienna Symphony Orchestra.

Distribution of "Magnecordings by Vox" throughout Latin America will be handled by Magnecord Western Hemisphere, Inc., 89 Broad St., New York 4, NY, and to all other countries by Magnecord International Ltd., of the same address

AIRPORT EQUIPMENT

Magnecord Inc. also announces the design and construction of an assembly of magnetic tape recording and reproducing equipment to meet the special needs of the Civil Aeronautics Administration in the United States, the features of which are of widespread interest to airport operations.

This equipment is designed to provide uninterrupted recording of one to four voice channels so that a complete and automatic record of operational procedure may be maintained.

Besides its importance to airports, this equipment is valuable in affording continuous recordings of court procedures, meetings, and the operation of broadcasting stations.

The equipment consists principally of two Magnecorder mechanical recording units of four voice channels each, rack-mounted, with a plug-in type recording amplifier for each of the four channels, and a fifth amplifier to monitor any track on either or both recorders.

One of the first pre-recorded tapes to be released will be the Shostakovich Fifth Symphony. played by the Vienna Symphony orchestra, and conducted by Jascha Horenstein.

The playback feature consists of a separate unit, either portable or rack-mounted with integral loudspeaker and amplifier, and provision for earphones. Any two of the four channels on the tape may be played simultaneously.

Otto Klemperer, with Ilona Steingruber soprano and the Vienna Symphony Orchestra, presents another work on tape, The Mahler Symphony No. 2 in C Minor, The Resurrection.

A foot-controlled fast-forward mechanism is provided for transcribing and quickly locating information on any part of the tape.

The erasing apparatus is also separate and portable. This prevents accidental erasure of valuable information at the recorder or playback units, thus assuring control of the erasure of any tape.

Outstanding features of the specifications include: Use of standard ¼in tape. Tape speed of 1 7-8in per second, affording four hours of continuous recording on a 10in reel of tape.

Tape drive is from synchoronous motors, each unit driven separately, with nearly zero timing error and flutter below ½ of 1 pc. Frequency range is from 300 to 3000 cycles.

Automatic changeover from one recorder to the other assures continuous recording. Overlap time is adjustable from one to three minutes. In the event of tape breakage, change-over occurs instantly. Each mechanical unit is mounted on a separate door for easy front access. Each amplifier has two outputs in order to feed both recorder units simultaneously. A separate portable meter is provided to read bias and audio level. Magnecord Inc., is currently filling a large order for these units for the Civil Aeronautics Administration.

Mobile Service Tender

IN order to enable a Morris Minor saloon car to be tested on a 10,000-mile non-stop run, during which neither the engine or the road wheels were allowed to stop, a Sydney University engineering graduate, Jim Mackaness, of Huntleys Point, Sydney, developed a special mobile service station.

The test run, made by the Nuffield organisation, was conducted at the Goodwood motor racing circuit, and Mackaness designed the tender and had it built only 10 weeks. Towed by a small truck, it was so designed that the test car could drive inside it while continuing its run around the track, thus allowing driver and observer to be changed; fuel, oil, and water to be replenished, and checks and maintenance to be carried out on the engine.

When these services were completed the tender was accelerated and moved ahead of the test car, allowing the latter to continue its run. A radio telephone link was provided between the test car and the tender to facilitate manoeuvres. When only the driver and observer were to be changed the complete operation took less than three minutes.

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1332-3H	200-220-230-240	300	120	2 x 6.3V-2A; 5V-3A	53/3
1356-3H	200-220-230-240	400	150	5V-3A; 2.5V-5A; 6.3V--4A	70/-
1380-3H	200-220-230-240	450	200	2 x 6.3V-2A; 5V-3A	102/6
1371-8	200-220-230-240	500-600-750--850-1000	300	——	150/-
1400-19	200-220-230-240	565-500-425	250	2 x 6.3V-3A; 2 x 2.5V-3A; 5V-3A	110/-
1643-23	200 or 230 or 240	—	—	6.3V TAPPED 5V-2A (500V INSUL.)	17/6
1525-21	200-230-240	—	—	2.5V-10A (1000V INSUL.)	47/6
1305-22	200-220-230-240	—	—	2.5V-10A (3000V INSUL.)	75/-

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973-9	30	20	80	370	500	33/6
973-21	30	20	80	270	500	25/9
1012-1A	35	20	120	430	1000	35/3
967-1A	35	20	150	200	1000	46/-
956-1A	30	20	200	160	1000	57/9
1011-1A	30	15	250	160	1000	59/6
* 983-1A	25	20/5	30/300	90	1000	65/6
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WE'RE ALL WOULD-BE INVENTORS

I often hear someone say "I've got an idea for something that would sell in thousands." The number of people who begin to invent something is probably greater than the number who hope to write a novel. I have found one of the best conversational openings with a stranger at dinner is to say, "And how's the invention?" because everyone has either invented something, is inventing or is thinking of inventing it!

THE war has shown how extremely inventive is the ordinary man and woman in Britain. A thousand inventions and ideas a month poured into the Ministries and the factory organisations. Many hundreds of them were adopted. A very much greater number proved impracticable for one reason or another.

My experience in talking and writing to hundreds of "amateur" inventors suggests that the majority are doomed to disappointment and may, indeed, lose a great deal of money rather than make the fortune that is popularly supposed to come the way of the successful inventor.

The reason why their inventions are doomed to disappointment are numerous, but they fall generally under a number of heads. The commonest is that they have ingenuity rather than utility.

It is not sufficient for an invention to be ingenious, it must be useful in the broad sense that it accomplishes something more cheaply, quickly or easily than before. But it is always the ingenuity of their inventions that fascinates amateur inventors rather than the utility.

I remember having a new mouse trap demonstrated to me that was certainly the most ingenious I had ever seen. The details are forgotten, but at least six forms of sudden death awaited the mouse, and as many lures were ready to get him within range.

BUY A CAT!

The proud inventor asked me what I thought, and I had to tell him, "It is very ingenious but don't patent it, because a cat would be cheaper." Not only did the very complicated mechanism cost a great deal to make—setting the trap would have taken, perhaps, five or ten minutes.

The time factor, incidentally, is one frequently overlooked by amateurs in their favorite field of invention—labor-saving. It is little use saving "labor" if you waste time. I remember a washing-up machine that was certainly labor-saving in the sense that all you had to do was place the dirty crockery in certain positions.

But I estimated that it would take ten minutes to do this—almost as long as the ordinary housewife would have taken to wash them by soap and water methods costing one-tenth as much.

Another mistake is to invent some new way of doing something which is already done very well. I remember a lady who invented a new burglar alarm, and was so pleased with it she spent considerable sums on patents and models. The alarm consisted essentially of wires so placed that when a door or window was entered a gramophone was automatically switched on to play a record of dogs barking!

When I asked her, "Wouldn't it be easier to keep a watchdog with the added advantage that he could bite as well as bark?" she was definitely hurt, and nothing I could say would persuade her that her invention was not epoch-making.

It is fairly obvious that the usual alarm bell ringing inside or outside the house or in the nearest police station would be a great deal cheaper and at least equally as effective.

Most of the 30,000 patents taken out each year in England are mechanical, and it is important that inventors should keep to the class of work of which they have some knowledge. It needs long experience to improve some vital detail of, say, a motor car, but any ordinary user might think of a useful accessory to make repairs easier.

PROFITABLE FIELD

Remember that simple things for cooking, the house, knitting and woodwork are all among the most profitable fields of patents, and everyone is an expert in something! Another point is that when an article is very widely used any improvement must be tremendous if it is to make worth while the changing of all the tools and stocks which exist. To improve a lampholder would be a very difficult task from a commercial point of view because so many millions are in use.

All this may sound very discouraging, but in fact it is not so. Every year, people who may be called "amateurs," produce first-class ideas that in some way increase the wealth, health or comfort of their fellow citizens. To know what to avoid and to be able to examine your invention objectively is to avoid much disappointment and probable loss of money.

by Professor A. M. Low

People sometimes ask me, "What should I invent?" It is rather like asking for an idea for a short story or a novel! In my experience at least 50 pc of the art of invention is seeing something that is needed. Satisfying that need, to the man or woman of imagination and moderate mechanical ability, is rarely difficult once the need has been perceived.

The man who made a fortune out of crinkling hairpins, to prevent them falling out, had virtually solved his problems once he noticed that hairpins fell out, caused women inconvenience, and could be made to stay in quite simply.

I can, however, give readers one or two hints. Notice that inventions are not completely "new" things, but a combination of two or more old ideas. The most obvious example is the fountain pen—neither pen nor ink was original, the "invention" consisted of bringing them conveniently together.

So it is with every invention. The inventor carries someone else's idea farther, combining perhaps the principles of two others, in ingenious fashion.

Timing is important with inventions. You can be too soon both technically and psychologically. I demonstrated television before the 1914-18 war, and the wireless-controlled plane during that war. Both were too many years before their time.

If you have what you believe to be a really first-class idea at the moment, I advise you to keep it. While present economic conditions last, it is obvious that manufacturers will be more concerned in turning out quantities of what they are equipped to produce, rather than looking for new goods. When controls of labor and materials are lifted, and trade becomes competitive, it will be another matter.

WAIT THE MOOD

For certain things you must also catch the customer's "mood." The best example I can think of is the game of Monopoly which swept America like wildfire during the economic blizzard years. Deliberately or accidentally it exactly provided the entertainment needed at that time.

Very little has been done to help inventors, yet they are really important to any country for they pave the way to new industry. In England we have the Institute of Patentees which is an organisation entirely devoted to helping inventors. The institute organises exhibitions, gives report upon inventions, free legal advice as to agreements or royalties, and generally helps its members to find the right manufacturer for their ideas.

Patentees who find their ideas being pirated can go to the Institute for advice.

Above all, remember that it is the amateur who has excelled in the art of invention. It was not official bureaus which were responsible for the steam engines, spinning machines, the telegraph, radio or x-rays. Originality is a country's most vital asset. It cannot be regimented by hidebound committee men.

Vast in area and still largely unexplored, the ocean holds many secrets. It covers nearly three-quarters of the earth's surface and ranges in depth up to 34,000ft.

WHAT LIVES DOWN IN THERE?

Man, by his nature, is an inquisitive individual. He is forever attempting to invade the regions of the unknown in order to satisfy his craving for greater knowledge of the world around him.

by Calvin Walters

SCIENTISTS have penetrated into the outermost recesses of the starry universe and are constantly building larger and better telescopes in order to see what lies "beyond."

Aviators, with faster and better machines, fly into the stratosphere, and further if they can, to find out what goes on.

Rockets with tremendous power are shot up into the sky equipped with the latest instruments for detecting almost anything which happens to lie around loose "up there."

Explorers penetrate dismal jungles and swamps and icy regions looking for "something."

Archaeologists dig enormous holes in unexpected places, unearthing strange ruins of ancient civilisations and tombs full of ancient mummies and skeletons.

ATOMS, EXPLOSIONS

Others pry into the secrets of the atom and try to rip the world apart with violent explosions. Bigger and better explosions seem to be the order of the day.

In other directions income tax investigators hold inquiries into the private affairs of their victims, and Royal Commissions sit for months trying to find out where the "grog" goes to.

Even some next-door neighbors are not averse to peering at one through the venetian blind in an effort to learn as much about your affairs as the neighbor on the other side.

Man has now turned his attention with increasing vigor to exploring the floor of the ocean.

These regions of the earth have long been a mystery to man. They certainly have been to the writer and many others who on occasions try their luck with rod and reel. As a result of my investigations in this way over the years I have long held the view that the ocean is particularly lacking in anything whatever.

This view, however, has now been proved to be erroneous, for the latest discoveries have shown that the sea really has something in it, besides seaweed and other snags.

Of course, these explorers are equipped with cameras, hydrophones, sonar apparatus and other aids—things which the average fisherman does not carry around with him. It is little wonder that these chaps can find more things in the sea than one whose sole equipment is a rod, reel and a demijohn full of you know what.

The earliest known occasion of any living thing being brought up from great depths of the ocean was during the Arctic expedition of Sir John Ross in 1818. From a depth of 1000 fathoms a sounding line brought up some tube-forming worms and at 800 fathoms a starfish entangled itself on the line.

It was at once thought that the sea bottom at 300 fathoms was a desolate waste, containing nothing but wrecks, old iron junk and empty beer bottles—relics of the ancient mariners.

Nobody had ever been down there, because its very nature precluded the possibility of anyone ever making a personal observation. Most of the explorations in those times were carried out by means of the sounding line, trawls or dredging. Samples of the bottom were taken in this way.

In order to grasp the immensity of our ocean systems, it is well to give a few figures.

The globe is mostly a world of water. There is about 51-million square miles of dry land, but there is 140-million square miles of ocean.

HILLS AND DALES

The Pacific Ocean alone covers some 67-million square miles, nearly one-third as much again as the total land surface.

The depth of the ocean varies up to 34,000 feet and the floor is not a vast plain, but is broken up into mountains, valleys and canyons, just the same as the land surface.

The deepest part of the ocean so far discovered lies off the Philippine Islands, and is 6½ miles deep. It is called the Mindanao Trench.

The mountains of the sea rise up from the floor to immense heights. The average height is 12,000 feet, but in some areas they rise to heights of 30,000 feet.

There are immense canyons which, had they been on dry land, would have provided scenery and grandeur far exceeding that of the canyons of America and other parts of the world. Their origin is a mystery and it has been suggested that they are no more than a million years old.

These canyons are steep cliffs, sloping down at an acute angle to a narrow floor, and are likened to the river-cut canyons on land.

How they were carved and by what agency is a matter of mere conjecture, but their location in some places suggests a continuation of the large rivers of the earth.

INDIRECT METHODS

For instance, one of the largest canyons, the Hudson Canyon, starts at the estuary of the Hudson River and continues for more than a hundred miles out into the floor of the Atlantic Ocean. There are similar canyons leading from the mouths of the Mississippi, the Congo, the Columbia and other large rivers, which lead to the suggestion that perhaps at one time these submarine canyons were perhaps on dry land until some catastrophe of nature caused the land to sink beneath the sea.

The task of exploring such an immense and complicated system is a prodigious one. Everything must be done with instruments, except the exploration of the comparatively shallow upper layers of water where it is possible for man to make personal observations.

The greatest depth to which it is possible to descend in the most modern diving outfit is about 500 feet. Other means have been devised for man to descend to greater depths, but this has only been accomplished twice. William Beebe and Otis Barton descended to a depth of 3000-odd feet in 1934 in a specially-designed "bathysphere." Later in 1949 Otis Barton descended to 4500 feet.

The greatest difficulty for man is, of course, the great pressures encountered.

On land the pressure exerted on our bodies is 15 pounds per square inch, but in the sea the pressure increases by 15 pounds per square foot for every 33 feet in depth.

There is very little compression of the sea under its own weight, but the underlying layers of water suffer somewhat by the bearing down upon them of miles of water above. If this bearing down was removed, it is calculated that the sea-level would rise some 90 feet all over the world.

LIGHT ABSORBED

With regard to the light which penetrates the depths, it has been found that the red rays are gone at 300 feet. Between this and 1000 feet the green rays disappear, and at 1000 feet there is only dark blue. At greater depths than this all is complete and utter darkness.

It will be seen from the above that any life in the ocean must be adapted to a wide variety of environments.

First, there are the surface fish and other life. Here we find a wide variety of color, with perhaps a preponderance of blue and green. Herring and mackerel and that creature feared by all surfers, the bluebottle, have predominantly blue tints.

As we go down we find the water becoming bluer and so the fish become clear and colorless, an effect which blends well with the water and protects them from lurking enemies.

Farther down, at 1000 feet, we find many silver fish with red and brown. Some jellyfish are a deep brown. At lower depths the fish tend toward black or deep purple.

Sea life also adapt themselves in the environment governed by pressure. All that live at varying pressures move about in a restricted zone and rarely rise or descend above or below certain limits.

At great depths some fish are blind, presumably because they can't see anything any way. This disability has been overcome by the provision of sensitive feelers which enable them to grope their way in the total darkness.

UNDERSEA CAMERAS

Other animals have been provided with torches which can be switched on and off. Some have rows of lights which not only illuminate the encircling darkness, but serve as identifying marks so that their friends know them as such.

The methods of exploring the depths are varied. In addition to the sounding line, there are special cameras which, associated with powerful lights the whole being totally enclosed in a water-tight glass walled compartment.

Some remarkable photographs have been obtained with this gear.

The taking of a picture is entirely automatic and is accomplished by means of a rod on which the apparatus is suspended. When this rod touches the bottom it releases the camera shutter and sounds a buzzer in the vessel above. The gear is then raised about three or four feet, and the vessel moves to another place, where the process is repeated.

By these means continual photographs are taken over a wide area and much valuable information is obtained, such as the condition of the bottom, the number and kind of fish in a certain area, and the existence of other perhaps previously unknown life.

Much light is thrown on such matters as the feeding habits of fish and their behavior toward other fish. Not that there is any worry about whether a fish is rude to his neighbors or not, but there is importance in the knowledge of what fish will scare other fish away from their feeding grounds.

Large areas of the sea bottom in certain places have been found to be inhabited by millions of brittle star fish. They are so plentiful that they lie one on top of the other in layers. They seem to serve no useful purpose, and as they lie on the bottom at the rate of 250 million to the square mile, they consume an enormous amount of food.

RADIO AIDS

Life on the ocean bottom is far more plentiful than has been believed. One photograph at 6000 feet revealed an enormous spider 28 inches across. Other pictures showed groups of holes about three inches in diameter, obviously the home of some type of fish or animal, but no photo of the animal itself was recorded.

Sonar, that device which measures reflected sound waves, is used to map the contour of the ocean

IT'S A BIT DEEP FOR ME, MATEY!

Pressure prevents the ordinary diver from descending more than a few hundred feet. Special diving bells have carried man down to some 4500ft—with 30,000ft still to go.

LIGHT WEIGHT
SMALL SIZE
HIGH OUTPUT

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A high-quality all-purpose microphone incorporating many advantages to make it outstanding in its class. An aluminium alloy diaphragm with a carefully balanced compensator and a perforated chromium finished housing give a smooth overall response between 50 and 8,000 c.p.s. without any disturbing peaks or resonances.

The Alnico magnet ensures high output and light weight, and the resulting small size makes this microphone unobtrusive.

The standard $\frac{5}{8}''$ x 26 TPI mounting thread is set at a carefully selected angle to give the most effective coverage of the area in front of the microphone.

The actual movement is suspended on foam rubber inside the housing as a precaution against the transmission of mechanical vibration and a special internal lining of the case acts as a windshield and protection against dust.

TYPE	IMPEDANCE	CABLE (Shielded)	OUTPUT
S403	50 ohms	9 ft. Twin	.075 mV/μ bar
S404	Direct to Grid	9 ft. Single	1.7 mV/μ bar

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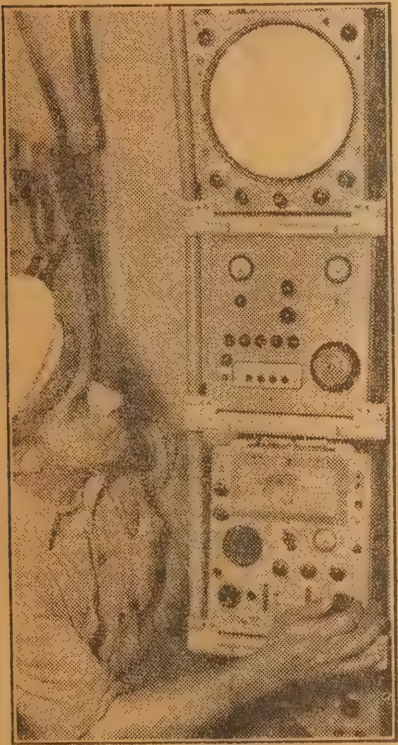
S2.52

floor. Its reflected echoes are recorded on charts and in this way a map is built up of the ocean floor.

Sound echoing was first developed to allow ships in motion to determine the depths of the water under them, but it was soon found that the sounds were reflected by any solid mass which they encountered. Schools of fish, whales and submarines, as well as wrecks, all reflected the waves. These were followed by waves reflected from the bottom.

One of the most controversial discoveries of recent years has been what is now known as the "false bottom" of the ocean. This is the name given to a layer of some kind over a wide area of the Pacific and hanging some 1000 to 1500 feet below the surface.

It was first discovered by sonic apparatus in 1942, and was first given the name ERC layer, after the initials of the discoverers, Eyring, Christensen and Raitt.



Aboard HMS Reclaim a leading seaman operates the controll panel for the TV camera. Lenses, focus and aperture can be remotely controlled, the picture appearing on the screen at the top of the picture.

In 1942, W. Johnson, a marine biologist, found that this layer moved up near the surface at night and sank into deep water during the day, a fact which suggested that it consisted of living creatures which needed darkness for existence, thus coming to the surface at night and sinking into the dark depths during the day.

It has since been found that this phenomenon is almost universal over the deep basins of the oceans.

No one has so far found out of what the layer consists, but that it is of some solid substance is certain because of its sound reflecting properties. Some say it is a layer of extremely small shrimp. Others say it may be a layer of plankton, the food substance of the sea. Others have a theory of millions of squid which follow a similar behavior to that of the layer.

In order to test the light transparency of the sea water, recourse is made to a device consisting of a photo-electric cell and a white wooden disc. The light reflected from the disc operates the cell and records the amount of light which penetrates the water at varying depths. The speed and direction of ocean currents below the surface is measured by means of an Ekman current meter. This is a device consisting of a propeller and a compass. The compass records the direction of the flow and the propeller records the speed.

Some sound observations are made with instruments towed behind a vessel and temperatures are measured at varying depths with reversible thermometers accurate to within 1/100 of a degree centigrade.

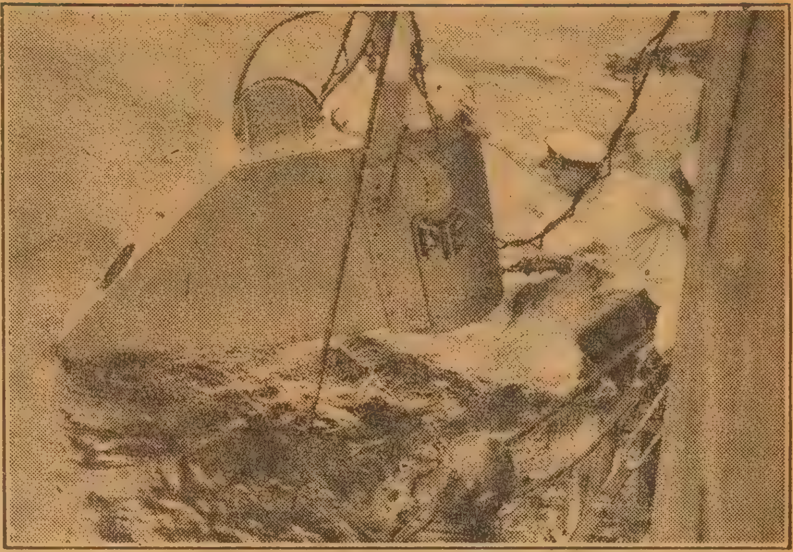
A very interesting observation made by scientists operating sensitive hydrophones, instruments for hearing actual sounds, is that the sea is by no means silent.

Many and varied noises come from the depths of the ocean and at times the noises produced by schools of shrimp and fish have been enough to put out of action the hydrophones which were used during the war to protect harbors from the invasion by submarines.

The small shrimp known as the snapping shrimp can kick up no end of a row. He has one only very large claw which he uses to bash his enemies on the head. He is always snapping the claw together, probably in anticipation, and the collective noise made by thousands of shrimp, notwithstanding they may be several fathoms down, make a terrific noise in the hydrophone like frying eggs.

Schools of porpoises make clicking noises as well as high pitched squeals and clucking. Other fish groan, mew, croak and drum, so that at night the medley of sounds through a hydrophone indicates the wide variety of life in the sea. So far no one has yet heard an oyster, but as he is reputed to be very annoyed at a noisy noise he must be in a continual state of unrest.

LATEST UNDERSEA TV SYSTEM



Latest device for undersea exploration is this British "Pye" undersea television camera. Installed in HMS Reclaim, the Royal Navy's 1850 ton deep-sea diving vessel, the camera was used to search for the submarine Affray. The camera weighs one ton and will transmit pictures from depths up to 1200ft.

MODEL CHECKS DELTA WING DESIGNS

A BRITISH aircraft company recently built a transparent plastic delta wing aeroplane, in model form, so that it could test the strength and construction of the wing shape in ground tests.

The transparent plastic material used, xylonite, shows up any internal weaknesses and deformations which occur when the model is subjected to the kind of stresses and vibrations it may meet in the air.

The model, with its spars and panels, perfect scale models of the original, took two and a half years to build, mainly because it was constructed direct from the original design drawings.

It had petrol tanks in the wing which were filled with a water 'fuel' for some tests, and a replica undercarriage.

Throughout its "life" the model was built and tested in a laboratory where the temperature was kept constant at 65 deg. F.

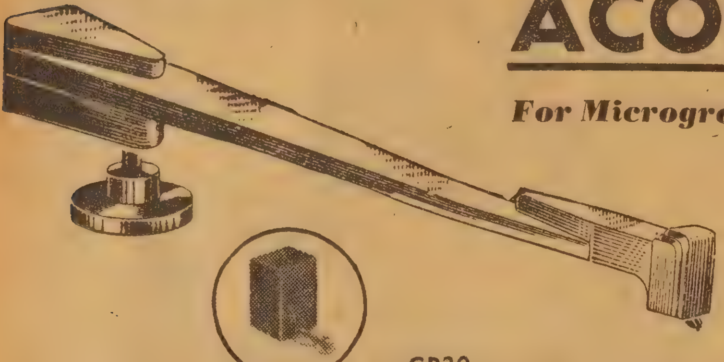
When under test, the model was subjected to trial loads and vibrations, and electric gauges were used to measure and record the experiments. In all, just under 1000 separate gauges were used on the model.

The recording equipment was capable of recording up to 168 readings every ten seconds.

The Finest Pick-up Available

ACOS G.P. 20

For Microgroove and Standard Recordings



GP20

Inset: The long-playing head. (GP 19LP) interchangeable with Standard Head (GP19).

GP9 Cartridge to fit GP10 Pickup .. Price 31/6

GP20

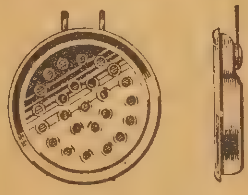
The GP20 pick-up is designed for use with the standard 78 rpm records for the 33 1-3 or 45 rpm long playing microgoove records. To meet these differing requirements, two interchangeable slide-on heads are available.

GP19 head supplied as standard.

GP19 L.P. head available for microgroove. It is something new in pick-up design and has 20 times greater output than comparable magnetic types, while needle talk and motor rumble are practically non-existent — permanent sapphire stylus — wide frequency response.

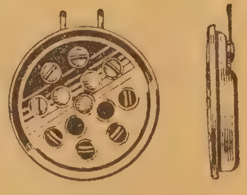
PRICE, GP20, complete with standard head,	£5/6/0
PRICE, GP19 LP head	£2/19/9
PRICE, GP19 standard head	£2/19/9

ACOS MICROPHONES and MIKE INSERTS



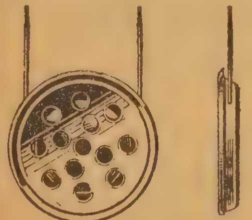
MIC 3

MIC3 Diaphragm-actuated Crystal microphone specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity.
PRICE, 39/3.



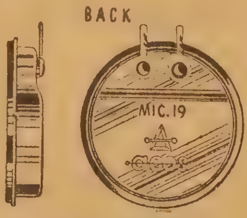
MIC 14

MIC14 Standard Speech Microphone itself with nickel-plate brass case which gives high corosion resistance, mechanical strength and rigidity.
PRICE, 39/3.



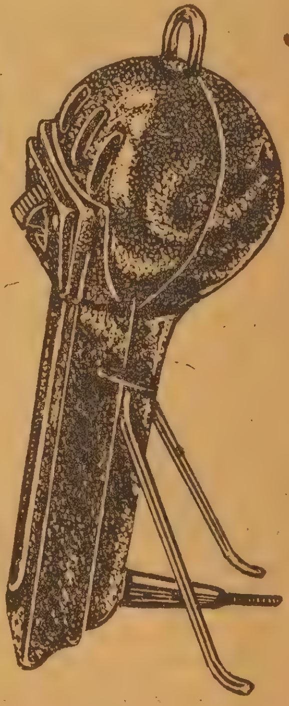
MIC 18

MIC18 Microphone Speech Insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required this insert is recommended. .. ..
PRICE, 39/6.



MIC 19/2

MIC19/2 Sintercel fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction.
PRICE, £2/19/9.



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Home Broadcasting: Exceptionally high gain allows direct use into pickup terminals.

Deaf Aids: Used by all leading Deaf-Aid Manufacturers.

Combination Hand-Desk Microphone. Type MIC30

This latest Acos release is a superlative new Microphone designed for use as a hand or desk microphone, and also incorporates a metal loop to permit of hanging it in a convenient position. The microphone is extremely compact and light, weighing only 6½oz and the height is only 7in. At the thickest point it is 2¾in. tapering down to 1 1-8in at the base of the handle.

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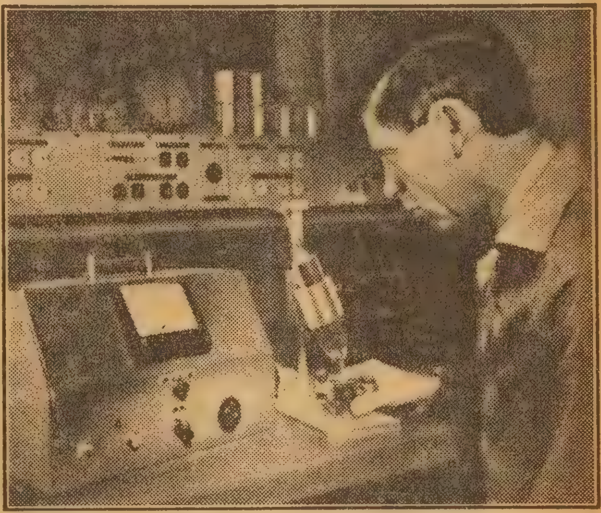
Technical Review

VIBRATING PLATE VISCOMETER AIDS IN BLOOD RESEARCH

A new electronic instrument which simplifies many previously difficult or impossible measurements of the viscosity of liquids was exhibited recently by research investigators of Creedmoor State Hospital, Queens Village, NY, in an exhibit at the annual convention of the Medical Society of the State of New York.



Dr. J. G. Woodward of RCA Laboratories Division demonstrates vibrating plate viscometer.

☆

CALLED a vibrating-plate viscometer, the device, developed by an RCA scientist, has been used in studies of human blood clotting rates by Drs. Arthur M. Sackler, Mortimer D. Sackler, Raymond R. Sackler, Co Tui, and Harry A. La Burt, of the Creedmoor Institute for Psychobiologic Studies, who have found that instruments such as this can open new fields of medical and biological study.

Their tests have indicated so far, they report, that such measurement of changes in certain physical characteristics of blood as it clots may serve to differentiate between psychotic and non-psychotic individuals.

Viscosity—the degree to which a liquid resists change in shape — has been in many scientific and industrial fields a troublesome thing to measure. In general, accurate measurements are long and tedious; whereas quick measurements are usually very rough and depend largely on human sight and touch. This has made difficult a continuous and significantly accurate measurement of a liquid in the process of thickening.

WIDE RANGE

The new RCA viscometer, a developmental model, can record at any range from low viscosity alcohol to high viscosity cold molasses. Its measurements are virtually instantaneous and they can be recorded over an indefinite period of time on a moving paper chart. The instrument can take measurements of a liquid whether it is in a huge vat or in a tiny container holding a quarter of a thimble full.

Designed by Dr. J. G. Woodward, of the RCA Laboratories Division, Princeton, New Jersey, the vibrating-plate viscometer consists of a thin metal disc, .2 inches in diameter, at the end of a metal reed less than an inch long. An electromagnetic motor causes the disc to cut back and forth through the liquid at approximately 800 cycles per second.

The plate makes its widest swing when oscillating in air but when dipped in a liquid the swing is restricted by the viscosity.

Mounted on each side of the reed are piezoelectric blocks, which generate a voltage when stress is applied to them through the bending of the reed. An alternating voltage is thus generated which is proportional to the swing, or amplitude of the plate. The more viscous the fluid, the more restricted the plate's vibrations are.

The resulting voltages are readily determined on a vacuum tube voltmeter and simply converted to viscosity values.

Besides its use in blood clotting studies, the device has been used experimentally by technicians of the United Clay Mines Corporation of Trenton, New Jersey, in charting the rates at which clay preparations harden in their moulds, a new and valuable type of measurement in the ceramics industry.

Many other possible applications can be anticipated for such apparatus in the petroleum, plastics, paint, textiles, printing, dye and other industries where precise knowledge of viscosity and viscosity changes is desirable.

HOW PENICILLIN IS PRODUCED

(Continued from Page 5

product of the corn refining industry, which has been found particularly useful for encouraging growth of the mould.

To extract or recover the penicillin in a strong solution, the contents ("mash") of these 10,000-gallon tanks are pumped through a rotary vacuum filter, which separates, as a scummy felt, the mycelium of the mould from the clear broth or "beer" containing the penicillin.

The "beer" is now subjected to a complicated solvent extraction process, thereby purifying and concentrating the solution of penicillin.

From this point onwards, including the packing of the dry penicillin powder in sealed vials, all operations take place in a "sterile area." This is a totally enclosed group of pressurised rooms into which sterile air is pumped. They have glass-lined walls and ceilings and impervious terazzo floors.

Access to this area is through an air lock. All operators entering the area are required to observe the same aseptic precautions as are practised by hospital operating theatre staffs.

Sterility is maintained in the area by ultra-violet lighting, the operators being protected from irradiation by masks, goggles, and surgical gloves.

In the area the concentrated solution of penicillin is crystallised, tested for potency, purity and contamination, and transferred to sterile rubber-stoppered vials.

In an adjoining department, the vialled material is retested before being labelled, cartoned and despatched to the various distributing firms.

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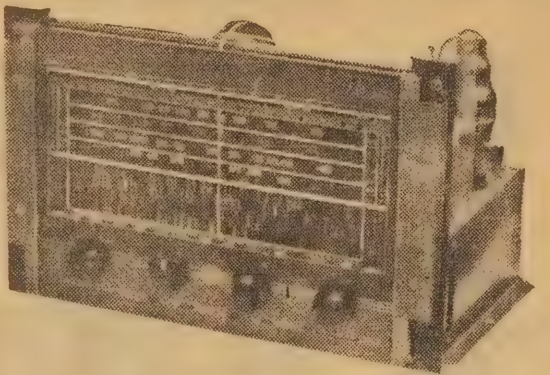

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- Tuning is made simple and positive even on overseas stations by the use of a super sensitive magic eye tuning indicator.
- All chassis are wired for the fitting of an F.M. or television tuner, special plug on back of chassis being provided, also standard 3-pin socket for power supply to motor.
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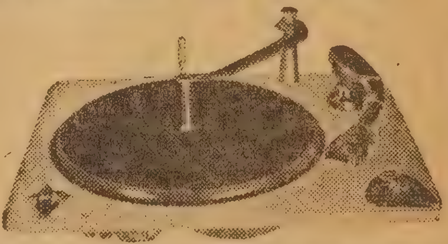

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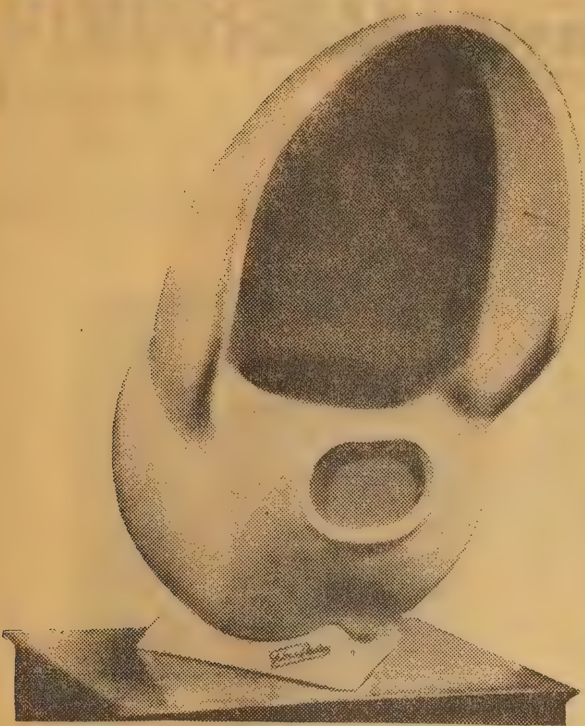
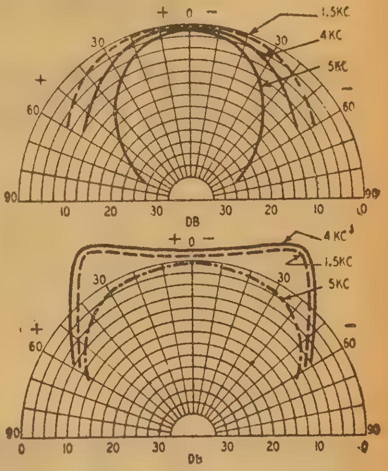
NOVEL FRENCH SPEAKER IS DESIGNED LIKE A SHELL

Methods of mounting loud speakers and providing efficient coupling between them and the listener is a particularly fertile field for the experimenter, the latest addition to the already numerous designs coming from France. In spite of the unconventional approach it is claimed to be superior to many other systems.



Left. The domestic version of the new French speaker horn which is shaped like a shell and made from glazed plaster. A larger version, intended for use in film sound systems, is similar in general style but larger and fitted with an adjustable cradle.



Right. Showing, top, the distribution of frequencies from a speaker mounted on a conventional baffle and, lower, the improvement resulting from the use of the new horn.

A SPEAKER mounted on a flat baffle transmits the middle range and part of the bass satisfactorily, but the higher notes are radiated in a narrow beam, so that the sound quality depends on the position of the listener.

For bass notes, reflection and refraction become very complex as the baffle dimensions approach the length of the sound waves.

Numerous acoustic systems have been devised in the attempt to distribute the high notes over an angle of 60 to 80 degrees, and to improve reproduction of the low notes with folded horns and resonant chambers. Another solution, recently developed in France, uses a conch-shell shaped element, which in form is part of an ellipsoid of revolution. (See photo.) An ordinary cone-type speaker is placed in one of the foci of the ellipsoid. Middle and higher-range sound waves from this point are collected at the other focus of the system, which becomes a virtual point of origin for the sound waves, diffusing them at a wide angle. (Fig. 1.) The special shape of the reflector concentrates the sound energy at one point in space, giving the subjective impression that the point is itself emitting the sound.

Bass notes are reinforced by a resonant chamber in the lower part of the equipment, with a carefully-calculated opening for the back-wave, following the principle of the reflex baffle.

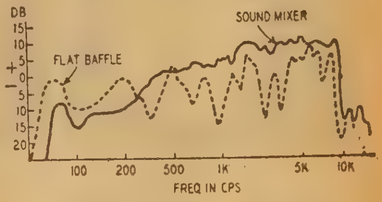
The complex baffle form is made of plaster. The surface is glazed to provide a reflecting surface for the higher frequencies. The interior of the resonant chamber is given a rough sound-absorbing finish.

The new baffle reduces intermodulation distortion and improves the efficiency of the speaker. (See Fig. 2.) In spite of the fact that only one speaker is used, there is a lifelike effect of depth, of a diffused source.

The concentration of sound toward the listener, with reduced transmission into neighboring spaces, will be especially appreciated in apartments.

An acoustic device of this nature must be used with a high-quality loudspeaker and a well-designed amplifier with precise control of the high and low ends of the spectrum.

At least two versions are at present being used, one the domestic model pictured above and the other a larger version for use in theatres.



Comparison between the frequency response of a speaker mounted on a standard baffle and one mounted in the new horn. Note the smoother response and elimination of peaks and dips.

NEW TAPE COPYING SYSTEM

MAGNETIC tape is used today for the original recording of nearly all new commercial discs, which are then produced by re-recording from the edited master tape. An obvious extension of this technique is the production of tape copies by means of a similar re-recording process.

A radically different approach to this problem has been adopted in the past few months by Dr. Francis Rawdon Smith, of Chicago.

A common mandrel, powered by a large, synchronous motor, is used to drive all the tapes involved, both master and slaves. This enables copies to be produced which are equal in length to the master, with an accuracy of better than one inch in 1200ft.

With this "Multitape" machine, as the designers have called it, 40 half-hour tapes can be produced from one master in an hour and these copies are virtually indistinguishable from the originals.

The mechanical arrangements of this machine are due to L. S. Toogood, but many difficult electronic problems had to be solved by Dr. Rawdon Smith before the final "Multitape" machine could meet the stringent requirements of its co-designers. Examples of these problems are (a) the provision of bias for as many as 12 channels, necessitating an unusually high-powered bias source; (b) as it is desirable to run the tapes very fast, to increase production, special equalisation is necessary; (c) the high tape speed necessitates a very high bias frequency, otherwise the recorded bias might fall in the audio range when the tape is played back at low speed; (d) this very high bias frequency also makes it necessary to use heads with extra thin laminations which, in turn, increases head wear unless special materials are used and tape tension is low.

This highly specialised equipment has been exhaustively tested for freedom from harmonic distortion, wow and flutter, or other defects which would mar the overall fidelity. It is claimed that when any copy is interspliced with the original master it is impossible to detect the change-over point, even on the highest fidelity equipment.

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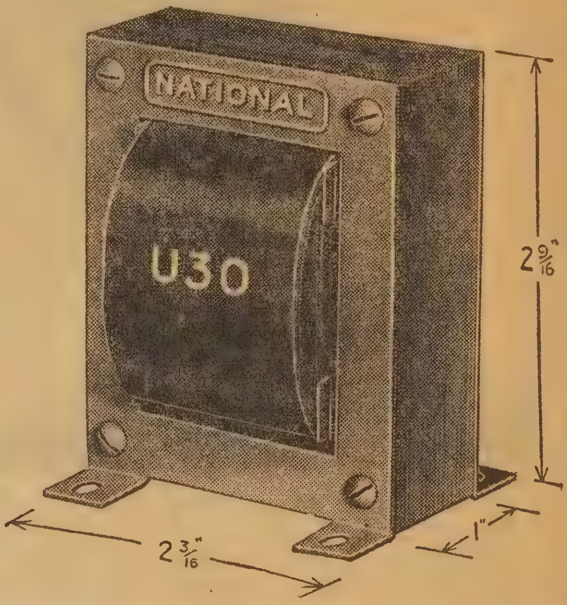
in the circuit requirements for your latest truly miniature receiver.
The National Midget U30/150 is the smallest transformer available, is ideal for miniature receivers, R.F. and Audio Oscillators and all compact test equipment.



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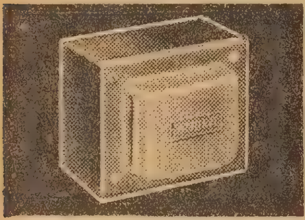
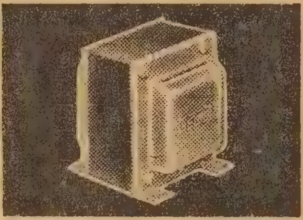
NOTE. The National U80/285 was selected for the "Wide-Range Six Receiver"—a set making a standard for the quality enthusiasts.





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U or F40/325	"	40	325/325	" "	Upright or Flat	45/6
U or F50/225	"	50	225/225	6.3v/2a	Upright or Flat	44/9
U or F60/285	"	60	285/285	6.3v/2a 5v/2a	Upright or Flat	53/2
U or F60/325	"	60	325/325	" "	Upright or Flat	54/1
U or F60/385	"	60	385/385	" "	Upright or Flat	58/3
U or F80/285	"	80	285/285	6.3v/2a 6.3v/2a 5v/2a	Upright or Flat	60/10
U or F80/325	"	80	325/325	" " "	Upright or Flat	62/4
U or F80/385	"	80	385/385	" " "	Upright or Flat	65/5
U or F100/285	"	100	285/285	6.3vct/2a 6.3v/2a 5v/2a	Upright or Flat	67/6
U or F100/325	"	100	325/325	" " "	Upright or Flat	69/-
U or F100/385	"	100	385/385	6.3vct/2.5a 6.3v/2a 5v/2a	Upright or Flat	76/5
U or F125/285	"	125	285/285	6.3vct/2a 6.3v/2a 5v/2a	Upright or Flat	85/4
U or F125/325	"	125	325/325	" " "	Upright or Flat	86/11
U or F125/385	"	125	385/385	6.3vct/2a 6.3v/2.5a 5v/3a	Upright or Flat	95/9
U or F150/285	"	150	285/285	" " "	Upright or Flat	89/8
U or F150/325	"	150	325/325	" " "	Upright or Flat	96/7
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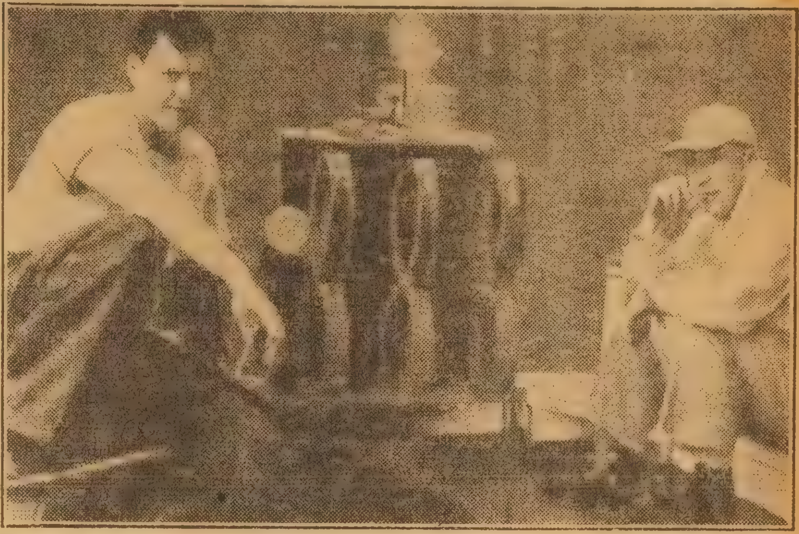
NEW MOVIE SYSTEM GIVES ADDED REALISM

BECAUSE true stereoscopic movies do not seem likely to ever be successful, Mr. Fred Walter, one-time head of Paramount's trick film department, has tackled the problem from a different angle, namely, that of reproducing the original scene so completely that the viewer gets the impression that he is looking at the real thing.

Basic principle of the new scheme, known as the cinerama, is that of photographing a very much wider angle of scene, both horizontally and vertically, than in normal motion picture practice and then of projecting these pictures on to a specially curved screen.

The angles covered approximate that of a normal person with two eyes and are 146 degrees horizontally and 55 degrees vertically. Since a single lens could not be made to cover this area without serious distortion, the inventor produced a special camera to do the job. It is really three cameras in one, consisting of three wide angle lenses and three separate film magazines, but having a common drive system and shutter.



This picture shows two of the technicians with the special camera. Note the three magazines required to accommodate the separate films for each camera. The two outside cameras are set at an angle

Motion picture engineers have dreamed about stereoscopic movies for almost as long as there have been movies. So far most attempts have either been clumsy or gave very poor results and it seems unlikely that any really simple system will ever be found. From America, however, comes an entirely new approach to this problem.

The three lenses are mounted side by side and the centre one points straight ahead while the two side ones are each set at an angle so that the left one photographs the right-hand side of the scene and the right one the left-hand side of the scene. To increase the vertical angle the size of the frame has been made half as high again as a standard frame.

When these pictures are presented, three projectors are used, occupying the same relative positions as the three cameras. The centre projector shoots straight ahead and covers the centre of the screen while the left projector covers the right of the screen and the right projector the left of the screen.

The result, as far as the viewer is concerned, is that the original scene is recreated so completely that he feels he is a part of it, and so gains the impression that he is looking at the real thing. The inventor claims that a sense of depth is provided by a number of factors other than the true stereoscopic parallax provided by two eyes and that these create a sense of depth when the scene is made sufficiently complete.

SIX SOUND TRACKS

A further step toward the recreation of the original scene is a unique sound system, which provides no less than six separate recording and reproducing channels. On the set five microphones are placed at strategic positions to cover the full width of the scene, and are fed to a special tape recorder which provides six channels on one wide tape. A sixth microphone is used to record special effects which might occur outside the range of the camera and particularly behind it.

When played back in the theatre these six channels are reproduced by six speakers occupying similar relative positions to the microphones on the set, five being located behind the screen and the sixth toward the back of the theatre. The overall effect of sight and sound is claimed to be so realistic that members of the audience involuntarily duck to avoid objects which pass close to the camera.

Apart from designing and building all the special camera and sound equipment there were quite a number of fundamental problems to be overcome. One was the increase in flicker when parts of the screen were viewed out of the corner of the eye, and it was necessary to increase the frame speed from 24 to 26 per second.

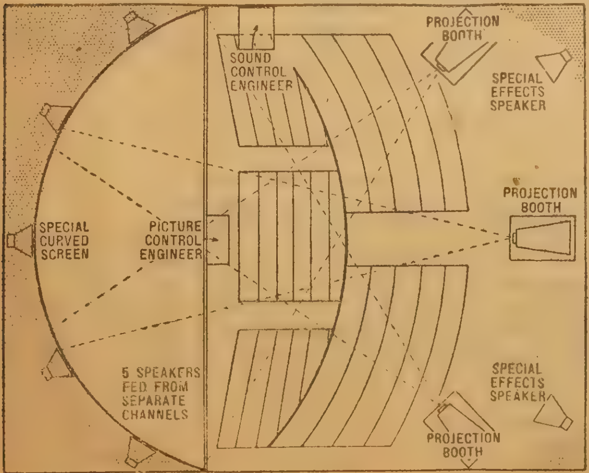
SCREEN PROBLEMS

The screen itself presented some problems since the curved surface tended to reflect light from any one point to other parts of the screen, seriously degrading the picture. This was overcome by constructing the screen, not as a continuous surface, but from a large number of vertical strips similar to the slats of a venetian blind.

This allowed the unwanted reflected rays to pass through the screen and is also claimed to eliminate the distortion of the image normally encountered when viewing it from the side of the theatre.

Merging the three pictures on the screen without a trace of joint also

(Continued on Page 99)



A plan view showing how the three projectors and six sound channels are arranged in the theatre. The picture engineer's booth in the centre is equipped to permit the three projectors to operate in absolute synchronism.

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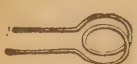
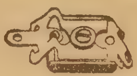
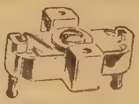
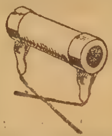
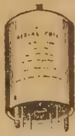
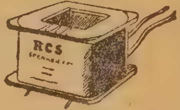

F.M. Coil.

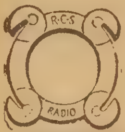

Trimming condenser.

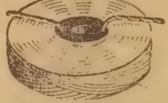

Padding condenser.

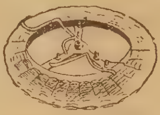

Resistors.

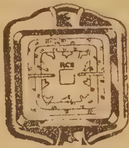

Standard broadcast coil.

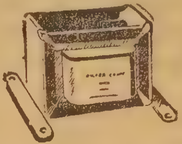

Speaker transformer replacement coil.

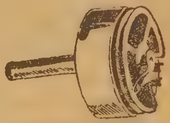

Transposition block.

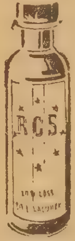

Radio frequency choke.

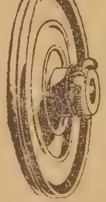

Loop aerial coil.

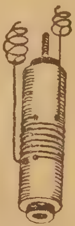

DA7 dial.

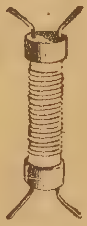

Filament transformer.

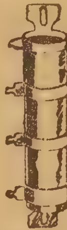

Potentiometer.

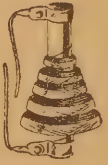

Low loss coil lacquer.

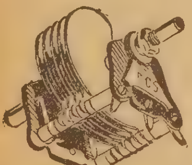

Dial drive drum.

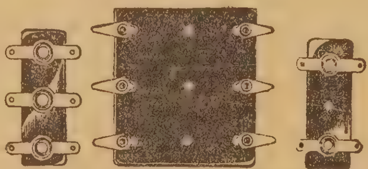

Short-wave Coil.

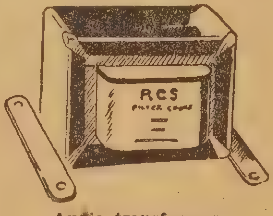

5 band coil.

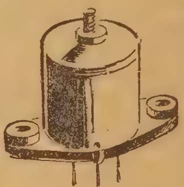

Voltage divider.


Radio Frequency Choke.


Midget variable condenser.


Resistance strip.


Audio transformer.


Midget Magnasonic Coil

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For HIGHEST fidelity in your R. & H. superhet wide band tuners use the special R.C.S. 1900 KC. coil kit type K124. The use of the R.C.S. 1900 KC. I.F. will ensure the utmost response from this clever Radio & Hobbies circuit. In common with all R.C.S. components, this new coil kit incorporates all the latest developments in I.F. design. Whether you're converting your old TRF, or building a completely new tuner, your all-round performance will be higher when you use R.C.S. components right through.

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NEWS AND VIEWS OF THE MONTH

Drug heals cut nerves

A new treatment that may overcome or prevent paralysis from damaged or cut spinal cords was recently reported to scientists at the National Institute of Neurological Diseases and Blindness in Washington.

Dr. William F. Windle, the man largely responsible for the treatment, cites the case of a patient in the Veterans' Administration Hospital in Richmond, Va., who has responded to the treatment, and who is known positively to have had his spinal cord cut across.

The treatment is in the form of a drug, pyromen, a polysaccharide derived from a micro-organism of the pseudomonas species. It was originally developed as a fewer producing medicine, but about two years ago it was discovered that very small doses would prevent the growth of scar tissue at the cut ends of spinal cords of dogs and cats. Nerve fibres grew across the cut ends and nerve function was restored.

Dr. Windle thinks that to do any good, the pyromen treatment must be started very soon, within a few days, after the injury or damage, unless an opeartion is done to remove the scars that have formed at the injured place.

A number of patients are now getting pyromen treatment. The one in Richmond, in whom a cut rather than a damaged spinal cord was proved, has regained some voluntary movement.

Another victim, paralysed and believed dying two years ago from a damaged spinal cord, was one of the first patients to have the treatment, and has now almost completely recovered. and can walk with the aid of a light brace. However, doctors point out that there is some doubt whether the spinal cord was actually cut and say that he may have recovered without the treatment.

* * *

Heart Valve

FOR the first time in medical history, surgeons have successfully installed an artificial valve in the heart of a human being.

The valve, a small plastic chamber with a plastic "pea" inside, not only saved the life of a 30-year-old woman but restored her to vigorous health.

The artificial valve was made for her by scientists at the National Bureau of Standards.

It is a chambered tube, 1½in long and an inch thick.

As installed, it becomes part of the aorta—the big artery that carries blood to the body from the heart.

Blood pulsing from the heart is prevented from rushing back into it by the plastic pea. which acts as a valve.

Recordings of the patient's heart sounds were made before the operation and afterward.

The sounds it makes now are those of a normal heart except for one difference.

That is the distinct click which occurs as the plastic pea "seats" itself against the backflowing blood.

* * *

A Real Phone

SOME day, whenever a baby is born, anywhere in the world, he will be given at birth a number which will be his telephone number for life.

This is one of several predictions made by Dr. Harold S. Osborne, chief engineer of the American Telephone and Telegraph Co., who is retiring after 42 years in the business.

"You ain't seen nothing yet!" is his conclusion, as he looked into the future and indulged in fantasies of the eventually possible.

As soon as the baby with the telephone number can talk he is given a watchlike device with 10 little buttons on one side and a screen on the other, the doctor explains.

At any time when he wishes to talk with anyone in the world he will pull out the device and punch on the keys the telephone number of his friend.

Then, turning the gadget over, he will hear the voice of his friend and see his face on the screen, in color and in three dimensions.

POPULAR SCIENCE QUIZ

Q: What is the most durable metal?

A: No one metal can be said to be the most durable. Steel, an alloy of iron with small amounts of carbon, is one of the most prominent of structural metals, used to support heavy loads. From the standpoint of resistance to corrosion, copper is a very durable metal. So is lead, as well as the "noble" metals, gold, silver and platinum. Tungsten is very strong when made into wire. There are many other metallic elements, and hundreds of alloys, which are very durable for particular applications.

Q: Is it possible to get window glass which will let in those rays of the sun which cause sunburn?

A: Yes, though it is rather expensive. Sunburn is caused by ultraviolet rays, which are a little shorter than those the eye can see. They are stopped by ordinary window glass. However, special glasses, which transmit these rays, are made. In addition, certain plastic materials transmit ultroviolet rays and plastic sheets for admitting ultraviolet have been used. However, these materials are not as durable as glass.

Q: Can I mix equal parts of 10 and 30-grade motor oil and get number 20 oil?

A: Two grades of motor oil may be mixed very easily to form one uniform, homogeneous oil. However, the practice of mixing an oil, such as SAE 10W, with an SAE 30 oil to get one of grade 20 is not recommended by authorities in the field. Although a satisfactory 20 or 20W oil would generally result, there are cases in which the mixture would be an SAE 30-grade oil. In addition, if the 10W oil used were a light or volatile one, the blend might well have poorer characteristics for oil consumption than an SAE 20-grade oil properly compounded.

Q: We are familiar with the term "plastic," but what does it embrace?

A: Generally speaking, a plastic material is one which can be made under heat and pressure to assume a predetermined shape. There are hundreds of plastic materials which fall into two main classes—Thermoplastic and Thermosetting products. The former can be softened and re-softened indefinitely by applying heat and pressure while the latter, on application of heat and pressure, takes a definite consistency and density which cannot be altered by further heat and pressure.

The early Egyptians and the Romans were, as far as we know, the first people to use plastics. They used resinous and waxlike masses found in the natural state. These belong to the thermoplastic group. One of the earliest examples of the use of plastics is the wax seal to be found on so many historical documents.

Shellac for gramophone records has its place in the field of plastics. Another well-known plastic is celluloid. Endeavors to reduce the inflammability of this material led to the production of cellulose.

Plastic products have many uses because of their comparatively light weight, smoothness and non-corrodable quality. Other outstanding features are heat-insulation and durability. They find use in industrial plants such as for small machine housings, fan blades, linings for valves and pipe lines, corrosion - resisting gears, water-lubricated bearings and such like.

The Ideal Gift for BOYS!

FOR THE YOUNG ENTHUSIAST! AMAZING G. Marconi EXPERIMENTAL 1 VALVE BATTERY RADIO-KIT

Nothing could be finer for a boy than one of these MARCONI Experimental RADIO-KITS. It's not a toy but a fascinating and safe way for him to learn about radio. It teaches the fundamental principles of radio assembly. It shows him the functions of various radio components. He can safely build his own 1-VALVE BATTERY receiver with real parts.
NO CONNECTION with the electric power supply!

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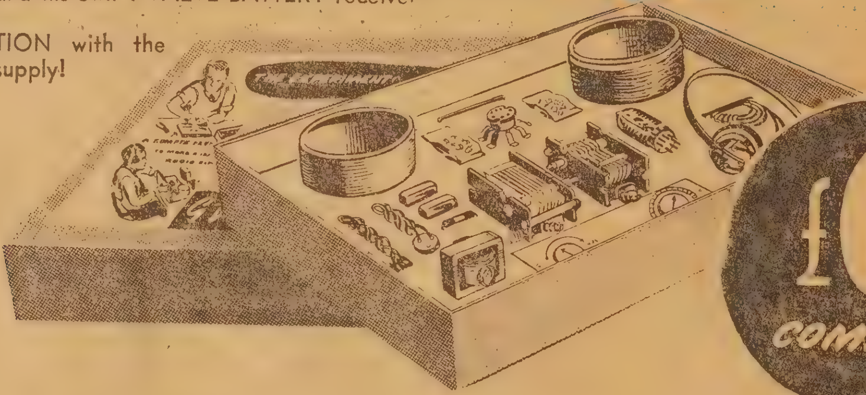

£6 COMPLETE

- COMPLETE SET OF PARTS FOR 1-VALVE BATTERY RADIO.
- NO SOLDERING NECESSARY
- FIRST GRADE COMPONENTS.
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- SENT POST PAID ANYWHERE IN AUSTRALIA.

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This is what the "MARCONI" contains

12 Connecting Clips.
2 Formers (1 for Coil).
1 x 70 mm fd. Condenser.
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1 x 2.5 Meg. Resistor.
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1 Valve Socket.
1 x 3V4 Type Valve.
1 Output Transformer
Connection Wire.
1 Variable Condenser, Tuning, 12 plates.
1 Variable Condenser, Volume, 3 plates.
1 x 3 volt Battery Cable.
1 x 45 volt Battery Cable.
1 x 3 volt A Battery.
1 x 45 volt Minimax B Battery.
Sand Paper.
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WE GUARANTEE TECHNICAL ASSISTANCE IF REQUIRED!

"If he does not see him and hear him, he will know that his friend is dead," says Dr. Osborne.

He sees other developments in the nearer future, which may have both advantages and disadvantages.

The lady of the house will be able to take the telephone with her when she goes for a walk in the garden.

She'll be able to make and receive her telephone calls there as she ambles around.

He said the great private-line systems, some equipped with automatic switching and with means for the storage and re-transmission of messages, now in use by a few large industries, may be the harbinger of special communications systems designed to meet the specific requirements of large enterprises or groups of users in the future.

* * *

Atomic Hail

RADIO-ACTIVE hail fell in Adelaide recently during a thunderstorm which swept the city and suburbs.

The hail was as large as marbles.

Mr. Bruce West, research worker in the chemistry department of Adelaide University, said the hail had double the radio-activity usually recorded by a geiger counter.

Mr. West has been testing the atmosphere since the Monte Bello atomic explosion.

Adelaide scientists have not yet determined if the explosion caused the hail's radio-activity.

The hailstorm was preceded by lightning and a terrific clap of thunder.

The noise drew thousands of people to office windows and terrified children.

Immediately afterwards hailstones half an inch in diameter began to fall.

* * *

Too Fast!

PILOTS of supersonic aircraft could not survive in combat without the aid of electronic equipment that worked faster than their own brains, according to Planes, magazine of the Aircraft Industries' Association.

Each advance in aircraft speed and performance called for the use of special electronic devices to compensate for the failure of the human element, the association contended.

Electronic gear in one jet plane was equal in complexity to the combined circuits of a city power system, a radio and TV station and the fire control system of a battleship.

Without this equipment human survival would be impossible, the magazine article said.

Increasing need for these pilot protective devices was a chief factor in the high cost of modern planes.

As an example, it pointed out that if two pilots flying directly at each other at 1200 mph emerged from a cloud a mile and a half apart they would not see each other before the crash.

They would be travelling faster than the speed of human nerve impulses.

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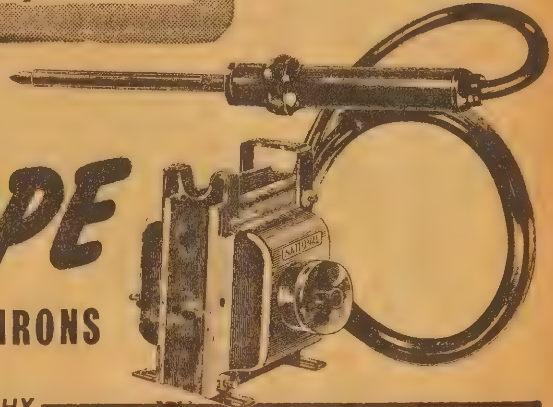

HERE'S WHY

1. Summer or winter, SCOPE takes only 6 seconds to heat up.
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Ask your local electrical supplier to demonstrate this highly efficient, safe, economical soldering iron.

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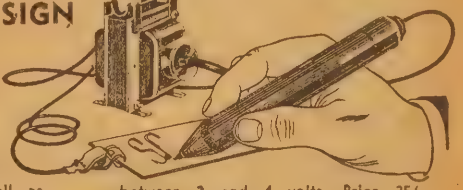

for indelibly marking ferrous and non-ferrous metals. Due to the vibrating movement of the tungsten tip the VIBROSCOPE has a mechanical as well as an electrical etching action. Operates from Scope's Iron Transformer, off AC/DC sources, between 3 and 4 volts. Price 35/-. Additional Tungsten Tips, 2/3 each. Full details from:

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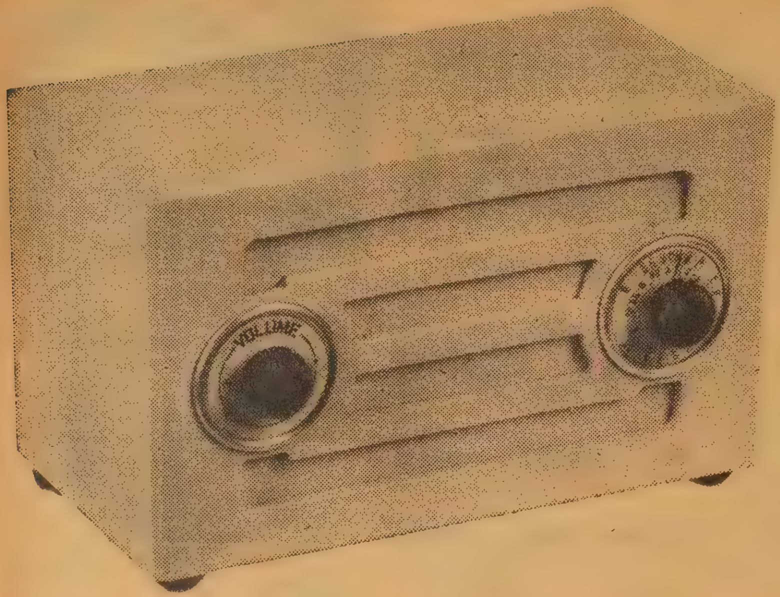


The small size of the set is difficult to gauge from this photograph. The cabinet, made in our laboratory with two or three items of woodworking tools, is finished in pale green with light brown fret covering. Note the indicator cards and backing plates mentioned in the text.

A NEW BABY MANTEL RECEIVER

Here is our smallest 4-valve AC-operated superhet to date. Designed to meet a popular demand for a miniature "carry-around" set in the home, it features delayed automatic volume control and a built-in loop aerial. Cabinet colors can be chosen to suit all tastes and, in fact, we tell you elsewhere in the issue how to build your own cabinet.

by Raymond Howe

OUR latest "baby" is quite a baby in size. It is a 4-valve AC-operated superhet., fitting into a cabinet measuring on the inside 7½in by 4¾in high by 3 7-8in deep. It weighs 4½lb complete, with cabinet, and can be balanced easily on three fingers.

It is ideal for the members of the household to carry about from room to room as a companion to daily activities and features a built-in loop aerial to add to this facility. Even so, the performance is excellent.

In actual tests at night with the loop aerial we tuned more than 20 stations capable of providing good entertainment level. With about 15 feet of wire attached to the loop aerial terminal, this figure was at least doubled.

PRIME OBJECT

The prime object of the set, however, is to give loop aerial reception of the local stations in a metropolitan area. It is not intended to stand in as the main set in the home. It is purely and simply a midget AC-operated "personal" mantel, small enough to be picked up in one hand and ready to provide entertainment when plugged into the power mains.

Of course, if circumstances require it, the use of an external aerial will take the performance a step further. Also there is room underneath the chassis to fit a standard miniature aerial coil, which will give a little more gain with an external aerial wire than will the loop aerial coil.

Whatever the minor limitations that miniaturisation impose upon this little set, it will meet all the demands you could reasonably expect of it. It is the smallest four-valve superhet. which it is possible to construct at the present with standard components and yet be capable of easy duplication by the average home constructor.

And when we say "easy duplication," we mean it—as the under-chassis photograph will illustrate. The wiring space may be small, but there is not a great deal to go into it. Because of the lower operating voltage, we have been able to simplify the circuitry to quite some extent with a consequent reduction in the number of components.

The cabinet, too, is of straightforward construction and could be easily put together by any home handyman with a minimum number of woodworking tools. We are giving all the necessary details elsewhere in this issue.

STATION INDICATOR

A limiting point with small sets is the matter of a suitable station indicator. A conventional dial would be out of the question because of the size and the restriction on layout. Also we wanted something better than a direct drive knob.

Fortunately, the matter was solved rather neatly by the recent introduction on to the market of a miniature two-section tuning gang with a planetary reduction drive built into the ¼in shaft. To go with this drive is a 1¾in diameter indicator plate with the stations marked in their positions, the local stations being made to stand out from the rest. Plates are available for each capital city. A matching plate for the volume-control knob is also available.

The combination of the reduction drive and indicator plates is a good one for small sets such as this one.

The electrical design of the set has been simplified to an extraordinary degree because the set operates at a lower high tension voltage than most other sets. It all has to do with the power transformer voltage.

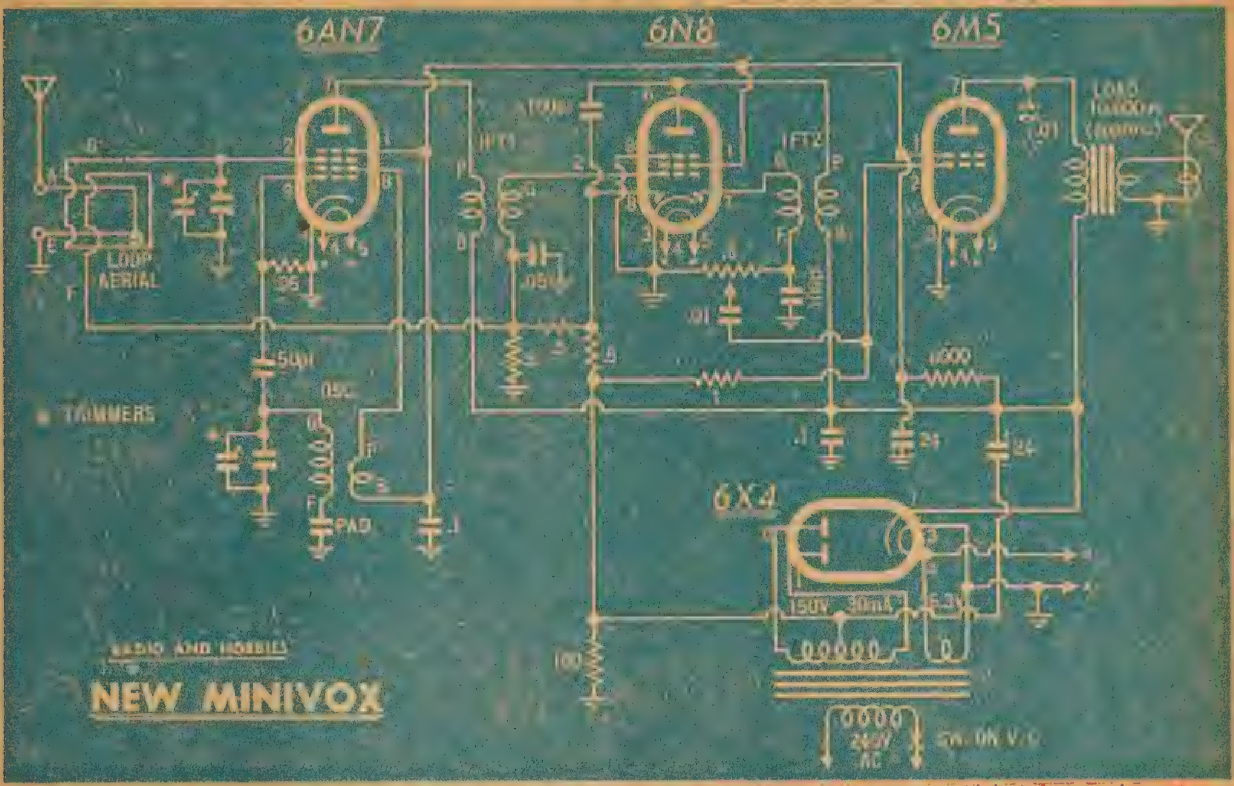
POWER TRANSFORMER

The smallest power transformer available has a high-tension secondary voltage output of 150 volts at 30 mA. This rating has been available for quite some time, but the latest types have been reduced in overall size.

After rectification, the transformer voltage appears as 165 volts across the first 24 mfd filter capacitor. This is the plate supply for all valves. To keep the total current drain to within the 30 mA rating of the transformer, the screen of 6M5 output valve is operated at the same voltage of the other valves.

Taking the circuit step by step, we have employed the now-familiar 6AN7 converter in the first stage. It carries the loop aerial coil in the grid circuit. AVC voltage and

CIRCUIT USES LOOP, OBVIATES FILTER CHOKE



The small number of minor components is a result of lower operating voltage. Although there is no published data on the optimum load impedance for the 6M5 at these lower voltages, a figure of 10 000 ohms or a little higher would be near the mark. Speaker transformers presenting 7000 ohms or higher would give satisfactory results.

operating bias is fed to this valve at the low potential end of the grid winding of the loop aerial coil. This eliminates cathode circuit components and allows the cathode to be earthed direct to the chassis.

The oscillator anode and the screen of the valve are fed from the common voltage point, where just under 90 volts is available with no signal input. With signal input, this voltage rises because the developed AVC voltage increases the bias on the converter and IF valves and reduces their current drain.

In the IF stage the 6N8 duo-diode variable-mu pentode is used. This valve was chosen rather than the higher Gm 6BA6 to avoid any possible instability problems which may otherwise face the home constructor. A small chassis and very high gain do not go together without special consideration to routing of wires and placing of components.

ADEQUATE GAIN

The 6N8 will provide plenty of gain and the overall sensitivity of the set is quite adequate for the purpose.

As with the converter stage, the IF valve is provided with AVC voltage and operating bias at the lower end of the grid winding of IFT1. The cathode is earthed to the chassis.

The screen of the valve is tied to the common 90-odd volt supply point. This supply point is, of course, bypassed for RF by a .1 mfd tubular capacitor.

The detector diode is fed from the secondary winding of IFT2 in series with the .5 megohm volume control potentiometer. This acts as the diode load impedance and all or part of the audio voltage developed across it is taken off by the moving arm of the control and fed to the grid of the output valve. The 100 pf capacitor provides the RF path across the load impedance.

There is an interesting arrangement of the AVC diode circuit and the back-bias network. The 100 ohm resistor in the centre-tap of the power transformer secondary winding has about 2.5 volts developed across it by the current drain of the set.

By tracing the circuit, you will see that three resistors in series, one of 3 megohms and two of .5 megohm, are connected across the 100 back-bias resistor. The AVC diode is connected to the junction of the two .5 megohm resistors, where, by the voltage divider action of the resistors, there appears a voltage of just over two volts.

This acts as the delay voltage for

PARTS LIST

- 1 chassis $7\frac{1}{4}$in by $3\frac{1}{4}$in by $1\frac{1}{8}$in deep.
- 1 power transformer 150V a side 30 mA, 6.3V 1.7A (nominal).
- 1 miniature 2-section tuning gang capacitor (with built-in vernier drive and complete with matching indicator plates).
- 1 miniature oscillator coil (to suit 6AN7).
- 1 miniature loop aerial coil.
- 2 455 Kc miniature IF transformers, Nos. 1 and 2.
- 2 gang section trimmer capacitors.
- 1 3-inch speaker with transformer to present load of 10,000 ohms approx.
- 3 9-pin and 1 7-pin miniature valve sockets.

VALVES

1 6AN7, 1 6N8, 1 6M5, 1 6X4.

CAPACITORS

2 24 mfd 350PV electrolytics, 2 .1 mfd 350WV (small), 1 .05 mfd 350WV (small), 2 .01 mfd tubular (small), (1 optional), 1 425 pf mica (low tolerance), 2 100 pf miniature ceramic, 1 50 pf mica.

RESISTORS

1 3 meg. $\frac{1}{2}$w, 1 1 meg. $\frac{1}{2}$w, 2 .5 meg. $\frac{1}{2}$w, 1 .05 meg. $\frac{1}{2}$w, 1 8000 ohm 1w, 1 100 ohm $\frac{1}{2}$w.

SUNDRIES

2 small knobs, materials for cabinet, 1 3-tag mounting strip, 1 $\frac{3}{4}$in. threaded mounting pillar, 3 $\frac{1}{4}$in i.d. rubber grommets, power flex and plug, scrap aluminium for odd brackets, hook-up wire. (7/.010 PVC), spaghetti, solder, solder lugs, nuts, bolts, &c.

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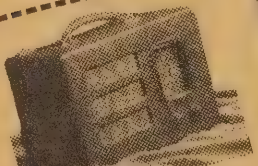
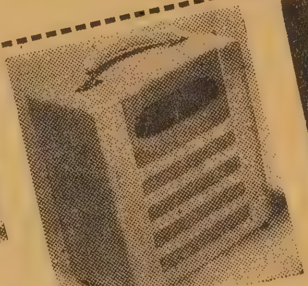


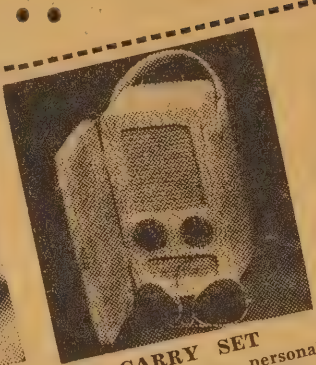
SENIOR PORTABLE

The ideal set for the picnic or the beach. "R. & H." design, this 5-valve B/C portable with R.F. stage uses either 6in. or 7in. speaker, size 12½in. x 8¼in. x 6½in.



JUBILEE PORTABLE

("R. & H." December, 1951). This 6-valve receiver with R.F. stage, is easily converted from A/C to D/C at the flick of a switch. Size 10in. x 10½in. x 6in.



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KIT SET SPECIALISTS

the AVC diode preventing it from developing a control voltage until the input signal has reached a certain level. This is called "delayed AVC."

The low potential end or "F" terminal of the winding in each of the converter and IF valve grid circuits is taken to the junction of the 3 megohm and the .5 megohm resistors where by the same voltage divider action as before, there is a voltage of just under 2 volts. This acts as standing bias for the two valves.

In addition to the action of these resistors mentioned above, the .5 megohm connecting to the 100 resistor also functions as the load resistance for the AVC diode and the other .5 megohm functions as the decoupling resistor feeding the AVC line.

COMPONENT SAVING

This arrangement works out nicely and saves a couple of resistors which, in the circumstances, is quite an advantage.

In the audio output stage, we used the 6M5 power valve. It has a high Gm and will give reasonable power output with very little driving voltage. Even with the low plate and screen voltages applied, the power output is sufficient to overload the 3in speaker.

As with the other two valves, the cathode of the 6M5 is earthed. The bias for the grid is obtained by returning the 1 megohm grid resistor to the "negative" side of the 100 ohm back-bias resistor, that is, the side not connected to chassis.

The screen voltage is taken from the 90 volt common point which is bypassed to the chassis for audio frequencies by the second 24 mfd electrolytic capacitor.

No suppressor resistors are used in the grid or screen circuits of this valve because parasitic oscillations would be unlikely with such comparatively low plate and screen operating voltages.

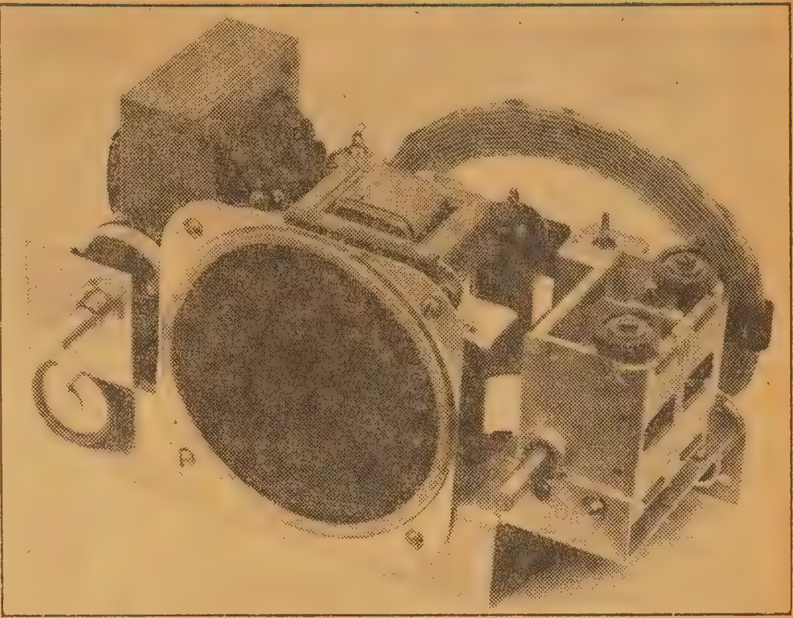
The .01 mfd capacitor shown dotted in the circuit diagram from the plate of the 6M5 and chassis is an optional component, its main function being to give some degree of treble attenuation. It can also help to stabilise the output valve if some indiscretion in the laying of the wiring to the grid and plate circuits of the valve leads to instability when the volume control is fully advanced.

POWER SUPPLY

Most of the story on the power supply has already been covered in discussing other parts of the circuit. The 6X4 is the logical rectifier to use in view of its small dimensions and 6.3 volt heater rating.

The output from the rectifier is filtered by the first 24 mfd electrolytic for the plates of the valves and by both 24 mfd electrolytics and the 8000 ohm resistor for the screens. The resistor also drops the voltage to the required level for the screens.

FRONT AND TOP VIEW OF SET



The view shows how the chassis construction provides support for the volume control, the speaker and the tuning gang. The layout will accomodate most other brands of 3-inch speaker. The volume control shaft should be cut to length and the control fitted before the transformer is secured in place.

This filtering is quite adequate as any residual hum is virtually inaudible at 2 to 3 inches from the speaker. A 25 mfd 40PV electrolytic across the 100 back-bias resistor would remove most of this but we did not consider it worth while worrying about. Even so there's room for a miniature 25 mfd electrolytic underneath the chassis.

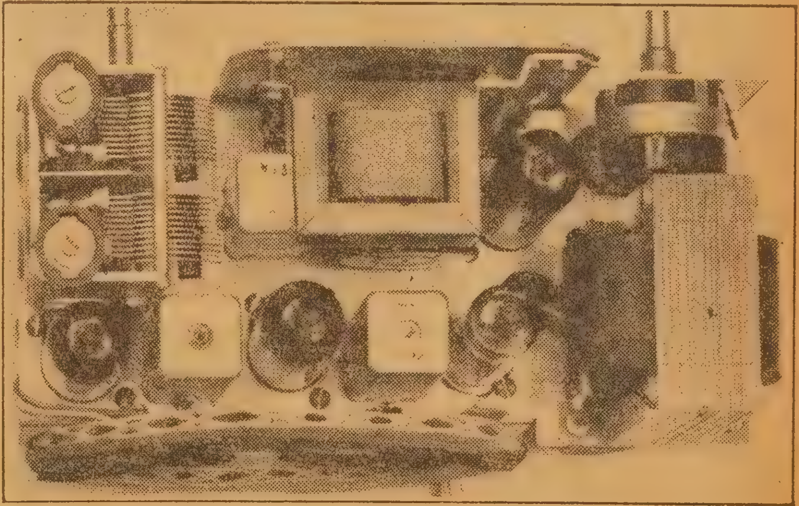
The 6.3 volt winding of the transformer is fully loaded by the valve heaters. Actually, this rating had some bearing on the choice of valves and it should be borne in mind if there is any thought of substituting valve types.

The full loading on the heater winding is partially compensated by a small under-loading of the high voltage secondary. The transformer will heat up to some extent but obviously this is due to the fact that miniaturisation has taken design figures pretty close to the limit.

Some heating will be contributed by the 6M5 and the 6X4 rectifier, but with an open back to the cabinet and the particular type of chassis construction convection cooling will give some relief.

Well, in brief, that's the story on the electrical side—now for the practical angle.

In small sets such as this, the chassis more or less serves the purpose of simply holding the major components together and providing a channel in which to lay the minor components and the wiring.



From the left along the chassis rear is the 6AN7, IFT1, 6N8, IFT2 and 6X4. The oscillator coil is to the left of the speaker and the 6M5 to the right. Note the off-centre mounting of the speaker transformer to clear the 6M5. The aerial tuning section of the gang is near the 6AN7.

ELECTRONIC FLASH TUBES

Who Would Have Believed?

Who would have believed a few years ago there would be available an inexpensive, non-expendable, synchronised flash tube—or, indeed, a complete range of tubes for almost every photographic application, including full colour photography? Yet, this is the case today.

As pioneers in the electronic art, Mullard have been manufacturing for many years, radio transmitting and receiving valves, electronic equipment and radio receivers, and, during this time, have truly pioneered many new developments including, of course, the perfection of a practical range of electronic flash tubes.

Prior to the recent war, electronic flash tube technique was extremely limited. Photographers seemed content wth expendable magnesium flash bulbs and synchronised flash mechanisms—a great step forward from the days of magnesium powder and ribbon holders, taper and ancillaries! The synchronised expendable flash bulb provided added facilities, particularly for press applications in breaking down the heavier shadows of subjects in direct sunlight.

Wartime Development

Wartime armament development requirements called for a light source of intense brilliance and of extremely short duration. Some flash tubes were available at the time, giving a flash duration of 1/500 second, although for the study of projectiles in flight—or disintegration—a flash duration of no less than 1-millionth second was required. After two years of trial, investigation, measurement and analysis, the Mullard Laboratories in Great Britain were able to produce microsecond flash tubes of consistent characteristics. This revolutionary tube, the "Arditron," was used extensively in U.K. wartime research and the present Mullard LSD 2 microsecond flash tube is a direct descendant of the original "Arditrons." With the incredibly increased velocities encountered in present-day engineering research, such as gas turbine engines, the LSD 2 is now finding world-wide application in industrial research photography.

Peacetime Application

The natural post-war development was, therefore, to apply the electronic flash tube technique to Press and Commercial photography and indeed, the more advanced amateur. Mullard engineers made a detailed survey of photographers' requirements of flash intensity and duration—film emulsion speed and exposure, weight and bulk of equipment, etc., and finally, developed the popular general-purpose flash tube—the LSD 3—a compact tube for portable equipment with flash duration 1/5000 second.

The immediate success and wide acceptance of the LSD 3 was followed by Mullard developing additional types for studio application and today the Mullard flash tube range includes many specialised types, such as stroboscopic tubes, strip tubes giving a line light source, quartz envelope tubes producing a light source rich in ultra violet, and large special tubes giving a peak light output of no less than 600,000,000 lumens!

In addition to the already comprehensive range of these "standard" Mullard flash tubes, Mullard engineers are continually developing the technique, and an additional service is offered in the manufacture of flash tubes to special order.

In this technique use is made of a high current discharge through a gas-filled glass tube to produce a light flash of high luminous intensity and extremely short duration. The procedure is to charge a capacitor of fairly large capacitance to a high voltage and either to allow the discharge through the tube to occur spontaneously or to initiate the main discharge by applying a subsidiary voltage to a third electrode in the tube. Mullard electronic flash tubes consist of a glass enveloped filled with an inert gas in which are located two electrodes. Dependent on the type of tube, the gas is contained in a cylindrical strip or spiral glass envelope and the third or trigger electrode takes the form of a ring surrounding one electrode (cathode), a gauze sleeve located in the centre of the spiral glass envelope or in the case of strip tubes, along the strip.

Enormous Advantages

Most enthusiasts are now acquainted with the application of electronic flash tubes to day and night press photography and also many professional photographers have already installed studio equipment; nevertheless, we take the liberty of pointing out the advantages of this revolutionary light source. Let us list some of these advantages over the expendable flash bulb and orthodox flood lighting. Electronic flash tubes provide—

(a) Independence of flash bulb supply position.
(b) Low cost per flash—very many thousands of flashes are obtained before the life of the tube is exhausted.
(c) Quick re-takes—no bulb changing.
(d) No hot expended flash bulbs to remove and dispose of.
(e) Reliability of flash—no misfires.
(f) Consistency of light output.
(g) Daylight colour spectrum.
(h) Shortness of flash resulting in exceptional ability to "freeze" motion.
(i) No annoyance of "startle" in subject.
(j) Easy synchronisation particularly with other flash units—by photocell methods without direct electrical connection.
(k) With studio flash tubes the provision of a modelling lamp at same source as flash. This results in a complete elimination of heat and glare and waste of power when posing of subjects.
(l) Considerable saving in power consumed from power mains.
(m) The light spectrum ideal for full colour photography.

Commercial Necessity

With such advantages, the commercial photographer, **to be competitive,** must avail himself of this new light source and, indeed, one enthusiastic flash tube user in Australia claims that in the production of a colour fashion magazine the total time taken was reduced to one-third of that by older, conventional methods using floodlights—not to mention the enormous saving in power, labour, and, of course, with less heat and glare, and a more amiable demeanour of models!

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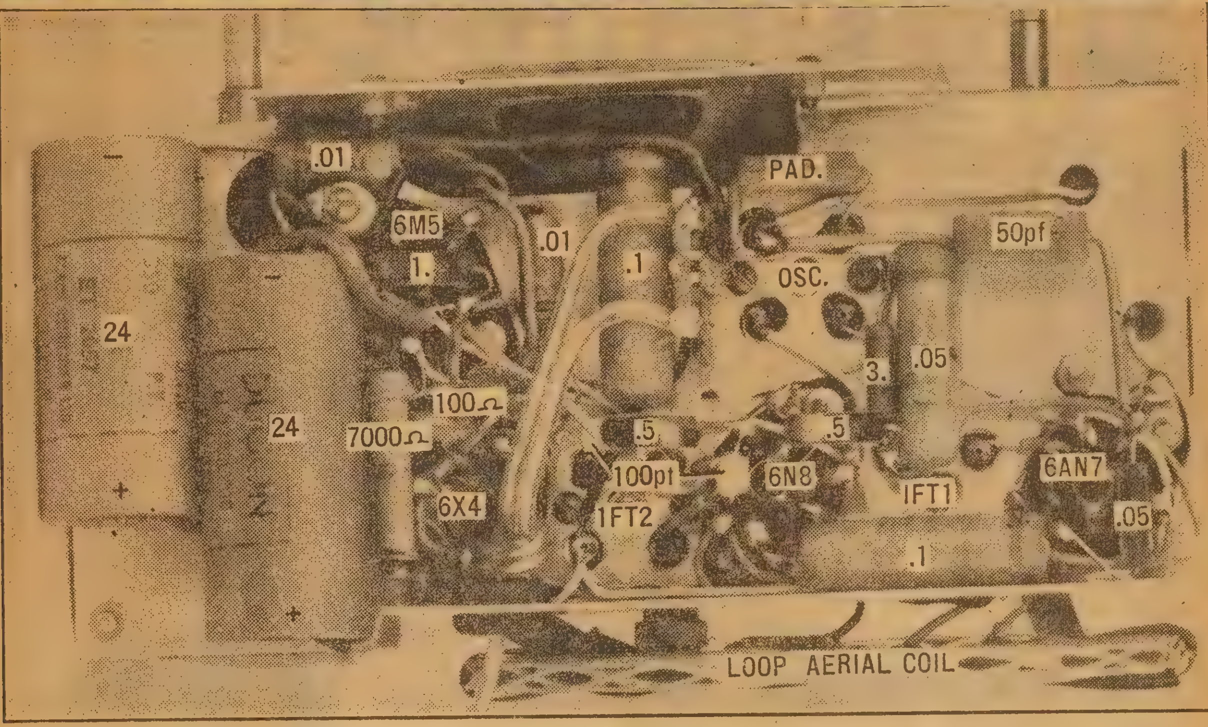
CLOSE-UP VIEW OF THE WIRING AND COMPONENTS



All minor components are visible in this underneath view. Used in conjunction with the circut diagram, you will be able to fit the components easily into the available space. There was no point in using a miniature 50 pf capacitor for the 6AN7 oscillator grid because of the length of lead involved. When the job is completed, see that no point of potential is shorted to chassis with drops of solder.

As far as possible, we arranged the bending of the chassis to provide mounting surfaces and support brackets for the major components. Apart from the couple holding the loop coil and one for the speaker transformer, we were able to get away with but one additional bracket to support the back face of the tuning gang.

The chassis will be available at most trade houses. The use of a ready-made chassis does save a bit of time and worry but, on the other hand, if you have had a little experience with making up your own chassis, you would not find much difficulty in producing this one.

A full-size blueprint of the chassis will be available for 3/6 through our Query Service.

COMPONENT LAYOUT

The various views of the chassis given here together with the associated block lines will enable you to position all of the components on the chassis. What you cannot see though is the particular orientation of the valve sockets, IF transformers and oscillator coil.

To assist you in this respect, this is the way in which we suggest you lay them. Mount the 6AN7 socket with the gap between the pins 1 and 9 toward the adjacent chassis side, the 6N8 socket with the gap toward the tuning gang, the 6M5 socket with the gap toward the 6X4 socket, the 6X4 socket with the gap between pins 1 and 7 toward the power transformer.

Mount the IFT1 with an imaginary line through the "G" and "P" pins, passing across the tuning gang, the 1FT2 with the same imaginary line passing across the 6M5 socket, the oscillator coil with the same imaginary line passing across the 6AN7 socket.

Place the volume control in position before fitting the power transformer.

Mount the transformer with the leads passing through a grommeted hole in the chassis near the 6X4 socket. Three bolts will be sufficient to secure the transformer, using those near the chassis edge. Countersink the head of the two diagonally opposite bolts, having the nut on the top side of the chassis. This allows the 24 mfd. capacitors to fit flush with the underside of the chassis. The inside lug of the transformer may be bent up if necessary to clear the 6M5.

RESISTOR COLOR CODE

VALUE	BODY	END	DOT
3 megohm	orange	black	green
1 megohm	brown	black	green
.5 megohm	green	black	yellow
.05 megohm	green	black	orange
100 ohms	brown	black	brown

For earth connections to the chassis, fit solder lugs under the two nuts holding down each valve socket and under one of the screws holding the oscillator coil. Connect all solder lugs together with a run of light gauge tinned copper wire to avoid any faulty earth contacts.

Lay in all the straight wiring runs, earth the centre spigot of each socket except that of the 6X4, and bend over to the spigot and solder any valve pins which should be earthed. Earth one side of the 6.3 volt heater supply at each of the valve sockets (except the 6X4), making sure that the same side is earthed in each case, otherwise the winding will be short-circuited.

It is definitely necessary to use miniature capacitors and ½-watt resistors, excepting the 8000 resistor which should be of the 1-watt size. The 24 mfd. capacitors are, of course, standard size.

With the 24 mfd capacitors, the inside one connects to the output of the rectifier, and the other one to the screen pin of the 6M5. The polarity is marked in the coded underearth view. The negative side of the inside 24 mfd. connects to pin 9 of the 6M5 socket. This is a blank pin on the valve and is used as a tie-point for the "top" end of the back-bias network.

MOUNTING PILLAR

A threaded insulating pillar is screwed on to the free end of the bolt holding the 6M5 socket near the speaker. This carries the junction of the .01 mfd. coupling capacitor and one lead from the volume control.

A 3-tag mounting strip is secured under one of the bolts holding the oscillator coil and carries the junction of the incoming mains lead and the primary leads to the transformer. Bend the lugs at right angles. When carrying out the initial tests on the completed set, remember always to keep your fingers away from this

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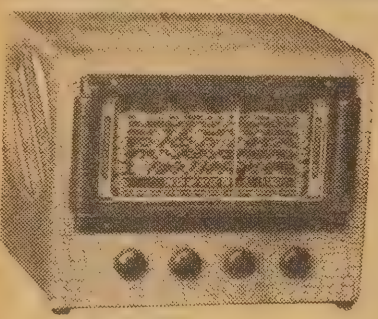

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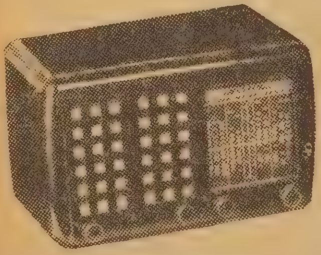

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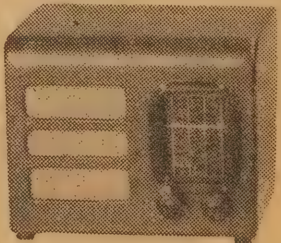

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tag strip, because it's too easy to make a slip when tipping the chassis this way and that.

The switch on the volume control is used to make the break one lead from the power transformer primary to the tag-strip junction with the mains lead. For added safety, slip a piece of spaghetti over each connection to the lugs of the switch.

The top view of the chassis shows how the speaker transformer and the loop coil are mounted. It is obvious that the speaker transformer will have to be of the small type. For the loop, two to ¼in wide aluminium brackets hold it about 3/8in away from the chassis. The grid connection for the loop should be toward the 6AN7.

LOOP RECEPTION

The proximity of the loop coil to the chassis will affect its inductance, its "Q" and its pick-up capabilities. Its position of mounting is, therefore, a compromise between performance and retention of the small overall size of the set. In some locations, it may be advantageous to mount it a little further away from the chassis, adding a little extra to the cabinet depth to keep it flush with the loop.

The alignment presents little problem. With the set standing on the transformer end for easy access to slugs and trimmers, tune in a station near the low frequency end of the tuning range. By moving the oscillator coil slug in small steps and "rocking" the main tuning to keep the station tuned in, select that position for the slug at which the station is tuned in at loudest volume.

Keeping tuned to this station, adjust the slugs in the IF transformers for best results. Place the station indicator card right on to the tuning gang shaft and position the pointer so that it indicates on the card the station tuned in. The whole will balance there for the purpose of alignment. The card, of course, attaches to the cabinet front later.

Select a station toward the high frequency end of the tuning range and "peak" the trimmer across the aerial section of the tuning gang for maximum volume. Adjust the trimmer across the oscillator section of the gang until the station is tuned at its correct marking on the dial card. Readjust the aerial trimmer for maximum volume.

SEAL SLUGS

It may be worthwhile repeating the alignment procedure. When satisfied with it, it is a good plan to drop a spot of coil dope or nail polish remover on to each trimmer screw and IFT and coil slugs, so that they will stay put when the set is moved about.

brackets to hold it about 3/8in away

Select a station towards the high

You may need to bear in mind that the loop aerial has an inherent property of directional reception. This means that when the loop aerial is moved through a line of direction at about right angles to a station being tuned, the signal level will pass through a sharp minimum.

Therefore, if a station is a little weak, simply rotate the set in one direction to make sure that the loop is not in one of its two "null" positions. Of course, due to signal pickup via the power mains, this "null" is not as sharp as with a battery portable and in some cases, it may not be noticeable.

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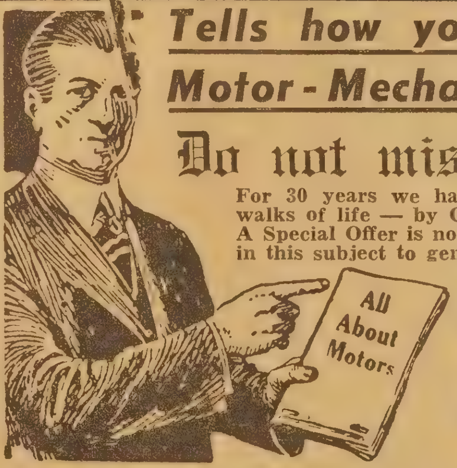

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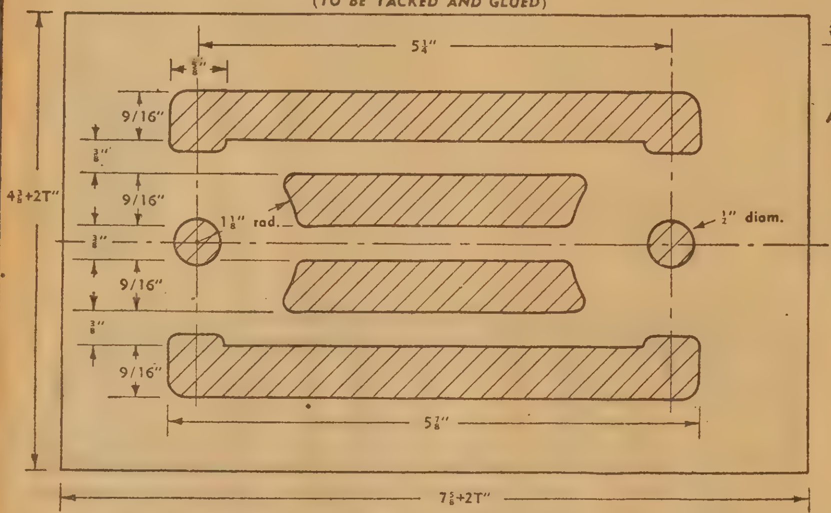
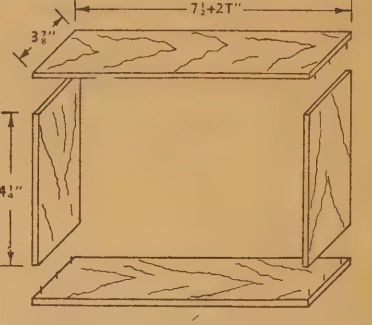
DETAILS OF PLYWOOD CABINET

The inside dimensions are 7½ inches by 3⅞ inches by 4¼ inches. Allowance must be made for thickness of material (represented by "T") when cutting top, bottom and front of cabinet to size. Note that the front is cut ⅛ inch oversize and planed or sanded flush with body of cabinet after assembly.



HALF SIZE DRAWING OF FRONT
(*TO BE TACKED AND GLUED*)



ASSEMBLY OF TOP, BOTTOM AND SIDES
(*TACK AND GLUE CORNERS*)

MATERIALS

Approx. 27 inches of ⅜ inch or 5/16 inch plywood 3⅞ inches wide.

Piece of three-ply 3/16 inches thick and 8⅜ inches by 5⅛ ins.

Fabric to match dial scale.

Piece of cardboard 7⅜ inches by 4⅛ inches.

Casein glue.

Panel pins.

There's no reason at all why you shouldn't build the cabinet yourself for our new baby mantel receiver. Materials cost only a few pence or you can use scrap plywood. In the way of workshop equipment you will need little more than a saw and a hammer. Have a go at it. It's much easier than you think!

FOR the body of the cabinet you will need a small quantity of plywood about 5-16 or 3-8 inches thick, while a piece of three-ply or other material about 3-16 inches thick can be used for the front.

The inside dimensions of the finished job are: 7½ inches long by 3 7-8 inches deep by 4¼ inches high. This gives a handy, although not excessive, clearance, just in case there is some discrepancy in the dimensions of the chassis.

The first job is to cut the thicker plywood to 3 7-8 inches wide, corresponding to the inside depth of the cabinet. In all you will need about 27 inches, but it need not be in one piece. The edges should be straight and square to ensure strong, glued joints.

STRAIGHT EDGE

When marking out the wood it is a good idea to start by making one edge straight and square and work from that. Rule a pencil line exactly 3 7-8in from the edge and parallel to it. To ensure that the marking is accurate, check that the rule is at right angles to the edge.

The pieces may be cut to width with a small wood saw. Position the cut so that the pencil line is cut neatly in two. You will find that this isn't as hard as it sounds if you take a little care.

If you don't have a wood saw, an excellent job can be done with a hacksaw, especially if you have one of the coarser blades. The blade will need to be put in at right angles to the direction of the frame, so that you can make cuts long enough for the top and bottom of the cabinet.

From the 3 7-8in stock you have prepared, cut off two pieces 4¼in long. They should be marked out in pencil with the aid of a carpenter's try square or an ordinary set square. If you have been careful with the saw these pieces could be glued up without any further treatment, but if the cut is a little uneven this can be remedied by taking a fine shaving with a plane or possibly rubbing the edges with sandpaper. Wrap the sandpaper around a piece of flat wood, otherwise you are likely to make any inaccuracies even worse.

The top and bottom of the cabinet should also be cut from the previously-prepared 3 7-8in stock. The length will depend on the thickness of the material you are using and, as you can see from the drawings, it should be 7½in plus twice the thickness of the material.

To complete the preliminary operations, cut the piece for the front from three-ply, making it 1-8in longer and 1-8in wider than the outside height and length of the cabinet. In other words, if T is the thickness of the timber, the dimensions of the front will be 7 5-8in plus 2T by 4 3-8in plus 2T. This allows an overlap of 1-16in all around. It can be sandpapered off later quite easily.

The next job is to assemble the top, bottom and ends, with the aid of some panel pins or very small nails. Stand the two ends on the bench and place the top piece over them, making sure as you secure each in turn that it coincides exactly with the ends.

TACK TOGETHER

Two panel pins, each about 5-8in long, will be sufficient for each for the purpose we have in mind. It is a little tricky to hold the parts exactly in place while you secure them, but provided you are aware that care is needed you will not have any trouble.

With the top in place it is an easy matter to turn the job over and secure the bottom. Drive the panel pins in straight, so that they will be easy to push out and then in again for the next operation.

Make distinguishing marks on ends and the top and bottom, so that the job can be pulled apart and put together the same way, without difficulty. The reason for using the panel pins is that the job can be put together quickly and accurately when the glue is applied.

Ordinary hide glue, as normally used by carpenters, is excellent if you have means of preparing it, but many constructors will find casein glue more satisfactory becasue it does not require heat for its preparation. You simply mix the powder with water, according to directions, and allow it to stand for about 15 minutes, after which time it is ready for use. During that time it will go hard for about 10 minutes before it finally assumes the normal consistency of glue.

With the parts of the cabinet dissembled, smear the glue over the mating surfaces. The top, bottom and ends can now be put together easily and quickly simply by pushing the panel pins into their previous holes. With the parts positioned you can put two or three more panel pins in each joint to help hold them firmly in place until the glue has a chance to set.

GLUEING TOGETHER

The edges facing the front and the corresponding part of the three-ply front can now be coated with glue and held in place with panel pins while the glue sets. Secure the front to either of the long edges and then make sure that the cabinet is square before securing the opposite edge. Once lined up, the front will hold the cabinet square. The allowance of 1-16in allows for a slight discrepancy in the dimensions, but at the same time you can easily see if the body of the cabinet is out of square.

Allow the glue 24 hours to dry before going any further. Some sandpaper wrapped around a flat block of wood about 2in by 4in can be used to rub the front level with the rest of the cabinet and take out any slight uneven parts where the joints are made.

Unless you have been very careful and also very lucky there will be a few small defects where splinters have come out, &c. Plastic wood is an excellent way of dealing with these. A tube costs about 1/-. It handles much like putty, but when dry can be sanded much the same as wood. You can also use the plastic wood to fill the holes left when the panel pins are punched below the surface of the wood. In the finished job you will not be able to detect the position of the panel pins.

CUTTING THE FRET

With the cabinet assembled and the surfaces sanded smooth, you are in a position to deal with the matter of cutting out the fret in the front. We found that the best approach was to draw the design full size on a piece of notepaper and paste it in position. When it is thoroughly dry you can cut to the lines on the paper.

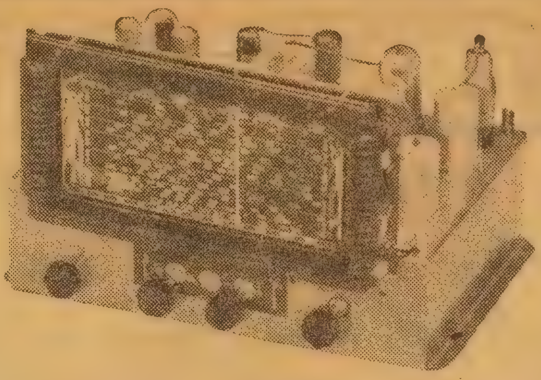
A coping saw or a fretwork saw seems to be the easiest way of handling the various cuts. Although it would be more tedious, it would be possible to drill a series of holes around the inside of the cut and then file accurately to the lines.

When you have finished, remove all traces of the paper and paste by rubbing with sandpaper.

It is a good idea to round the corners and edges of the cabinet somewhat. Not only does it improve the appearance, but it makes it less likely that the enamel will be chipped. This does not include the edges of the fret, which are best left fairly sharp.

With a certain amount of effort

(Continued on Page 99)



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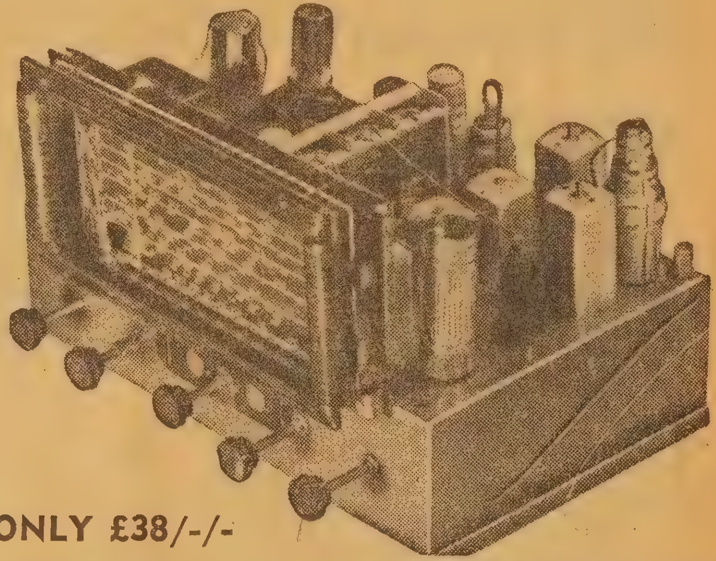

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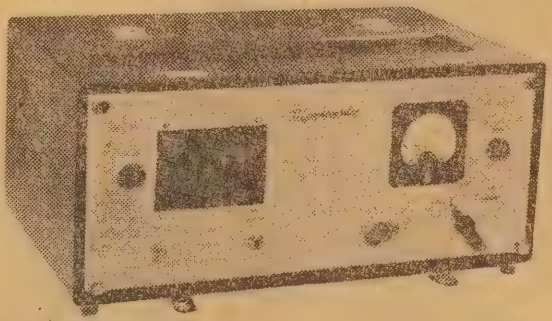

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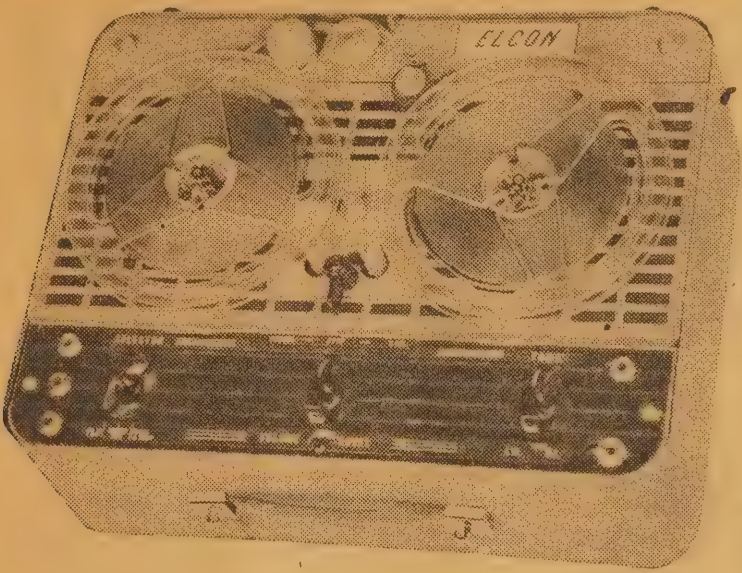

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SPECIFICATIONS

Weight: 30 lb. (complete with tape and microphone). Dimensions: 16" x 12" x 6½". Frequency Response: 50 to 7,000 cycles per second. Recording Specifications: 7½" per second. ½ hour play on single track.

[redacted]

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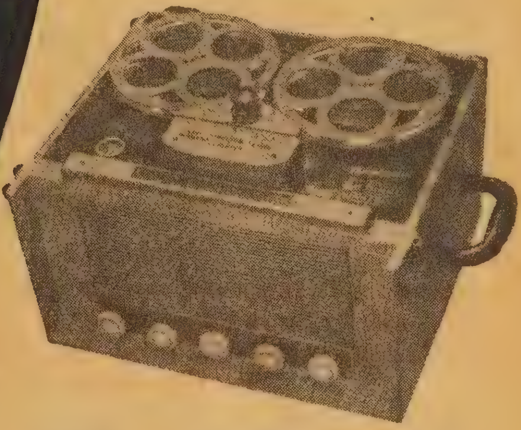

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I must apologise to those who are not interested in tape recording as a subject for discussion but there seem to be so many arguments in the air and so much speculation about circuit design that I simply cannot pass it by. Even Messrs. Thomas and Thompson are still hard at it, this time about the complete recorder circuit.

OF course, I can imagine a few readers eyeing my own contribuions rather suspiciously and wondering whether I propose to take ides in the said argument or renain seated amiably on the technical ence.

Right now, the fence isn't a bad lace to sit when it comes to tape rguments, because the techniques re relatively unfamiliar to the averge engineer, and it's very easy to ull a real "boner." What is worse, aving published an opinion, it renains in print for the next 20 years, o be held in evidence against you.

Right now, I can claim no special nowledge or experience of tape echniques. To phrase it more haritably, I know a lot more about udio in general than I do about ape in particular.

Still, that mightn't be a bad thing n some respects, and the following omments are made more from this eneral viewpoint.

In the first place, I am heartily n agreement with Mr. Thomas' tatement that "nothing about tape ecording is cut and dried." May I go further and suggest that our whole approach is, as yet, very immature. I emphasise the personal pronoun.

I have heard dozens of arguments lately about tape and tape techniques, the one between Messrs. Thomas and Thompson, just happened to find itself published.

In most cases, the participants are earnest engineers who have worked hard in an unfamiliar field and obtained a workable end result. Thereafter, they tend to defend their approach in the most spirited fashion against all other points of view. Mentally, they are still too close to their own workbenches to appreciate the other man's efforts.

For example, you can buy a fight any day on the subject of heads—whether they should use a single-turn lamination or the regular stacked arrangement.

by W. N. Williams

One school will maintain that the single-turn idea is effective and simple to manufacture. The other school will suggest that a single-turn lamination saturates too easily, that the field can't be confined adequately for half-track work and so on.

DO THEY WORK OUT?

The arguments can be made to sound very impressive, with little diagrams and so on, and there is no doubt that they would apply with plenty of force to top quality professional equipment. But, in actual fact, I've tested ordinary run-of-the-mill examples of both types of head, and failed to discover any consistent and sensational difference between them.

In other words, there's not much point in getting all het up over theory if production difficulties prevent you translating it into corresponding practice.

I've heard felt pressure pads condemned as being less than desirable in principle than running the tape tightly around a convex surface.

Says one group, "The pressure pad is no good. It wears and clogs [redacted]

Says the other group, "Pressure pads are the only way to handle tape which crinkles at the edges. And they don't give any trouble!"

Well, once again, I've seen good examples of both systems, so there can't be much question of them not working. Because designer "A" struck trouble, it doesn't follow that designer "B" won't be able to make the same system work.

And so it goes on. Pillars versus pulleys, large capstans versus small ones, slipping clutches versus motors and so on ad lib.

All these problems interlock in the most intimate fashion. A motor may be discarded as too weak or too "wowy" for the job, simply because a clutch mechanism is heavier than it should be. And the clutch might have to be heavy because the pulleys and/or pillars are dissipating too much of the take-up torque.

Fix the pulleys, lighten the take-up clutch tension, and presto, the small motor suddenly comes good. And that is not mere ad-libbing.

(Continued on Page 43)

ABOUT TAPE RECORDING—THOMAS v. THOMPSON

Many readers have expressed appreciation of the discussion published last month between Messrs. Thomas and Thompson. Here is the second and final "instalment." Next month you may like to contribute some ideas. How about it?

To start at the beginning, I see that a low impedance head has been chosen. The doubtful advantage is the slightly higher playback voltage which may be obtained. Against this is the more obvious disadvantage that an input transformer must be used. The cost ranges from more than £8 to cheaper ones at £4.

The statement that the leads from a high impedance head should be shorter than a low impedance type is a common misconception. If both leads are shielded, then the low impedance circuit is more susceptible to electromagnetic hum, because of the lower signal voltages.

On a test, with a low impedance head, it was found that more hum was coming in the eight inches of head lead than in the head itself unless the lead was placed in a critical position.

I think it unwise to select a 6SJ7 as the preamplifier. Experience points to the fact that type 6SJ7 is the most noisy valve intended for audio equipment. A 6N8 or 6AK5 (EF94) would be more suitable. Type EF37A is the optimum choice.

The use of an elaborate level indicator on mediocre and supposedly inexpensive recorder is inconsistent. Unless one is going in for the best results and is willing to do a lot of experimenting to get them, it will usually be found that a level indicator is unnecesasry since the tape is very tolerant to over- and under-recording.

The complete circuit is intended to illustrate the various points which arise. The choice of a 6U5 does not mean that this is superior to a meter as a level indicator, or even that an indicator is essential; nor the choice of a 6SJ7, that it is preferable to a 6J7 or a 6AU6; nor the choice of a low-impedance head, that this gives better results than any other type.

The 6U5 is simple and effective; the 6SJ7 is a typical voltage-amplifier pentode, which can be replaced by any one of a dozen other types; and the incorporation of a low-imepdance head serves the purpose of showing how it would be connected in the circuit. The use of a high-impedance head for playback, for example, requires no special illustration.

Screened high-impedance leads should be as short as possible to minimise the shunt capacitance of screened flex, which can be quite high unless expensive RF coaxial cable is used.

As electromagnetic hum is more localised than electrostatic hum, the length of a low-impedance line has little bearing on the induced hum voltage. The remedy is to keep the cable away from transformers, &c., or to use a twisted pair, earthing one side at the transformer end only.

Mr. Thompson is presumably referring to the Australian-made 6SJ7GT. This valve is indeed noisy. The author uses the American-made 6SJ7, which is very satisfactory. A miniature type would be less microphonic; however, the 6SJ7 is so well known as to be almost standard, and was shown for that reason.

One can get along very well without a level indicator; in fact, the author made little use of them during the first two or three years of working on tape recorders; but it cannot be recommended as a general practice. The circuit shown only calls for two tubes and a handful of small components. Unlike designs which use meters or neon tubes, it is practically foolproof.

Straight after the PU or radio input comes a weak effort at tone compensation. It consists of a 3-to-1 voltage divider, giving a pitifully small bass boost and a treble boost whose maximum occurs at about 2 Kc.

Now comes the playback channel but where is the post-emphasis? With this circuit, one could expect no response above the tape turnover frequency, 2 to 3 Kc. at 7½in per sec. even if constant current recording had been used.

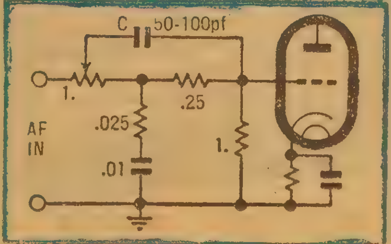
There has at various times been suggested by people who do not understand the fundamentals of magnetic recording that instead of feeding the recording head under constant current conditions, as is a disc recorder, it should be fed from a constant voltage source. I had, however, never seen a circuit along those lines until now. I do not think it will ever be used.

Nothing about tape recording is cut and dried. The art is still young and to say that a thing is impossible is to invite some backroom boy to produce proof that it is not only possible, but inevitable.

The author does not suggest that constant-voltage recording will supersede constant-current recording, but the principle remains. The development of boundary-displacement recording, for example, may well skittle our carefully-worked-out bias and erase systems.

The values shown in the circuit are only examples; it is not possible to specify a correction circuit suitable for all cases. With one head the turnover frequency may be 4 Kc/s; with another similar head it may be 6 Kc/s at the same speed.

One way to approach this problem would be to use a circuit such as that in the attached diagram. Here the bass boost is fixed, while the degree of high-frequency boost is variable. The capacitor C, the value of which can be found by experiment, should also be variable over at least a 2:1 ratio of different tape speeds or heads are to be used.



Illustrating a point in Mr. Thomas' argument—a circuit which gives fixed bass boost and variable treble boost.

Even the 6 db per octave rise is not invariable. This is most forcefully shown in the present case, where, owing to the constant voltage feed to the head, the bass boost required is very slight. Pitifully small, in fact!

The values shown would be inadequate for constant-current recording, but it would have been incongruous to show values giving 6 db per octave boost with the system of driving the head as used.

There is no practical comparison between constant-acceleration disc recording and constant-voltage tape recording. In a constant-current tape recorder with a 6 db per octave pre-emphasis, it will be found that the voltage across the head is more or less constant from the normal bass limit up to the turnover frequency, with a constant input to the amplifier. The effect at these frequencies is the same; the methods of achieving that effect differ.

Whereas with constant-current recording the response can be made level to well above the turnover frequency, it is difficult with constant-voltage to keep the response flat much beyond this point, which will be around 4 or 5 Kc/s at 7½, or 8 to 10 Kc/s at 15 ips, with good heads. The extreme bass may also suffer if the impedance of the head is too low to load the output valve properly at these frequencies.

The playback channel as shown has a substantially level response over the audio range. Its performance, therefore, will be as good as the tape and head will allow.

The suggestion that tone controls are unnecessary on a recorder is rather like saying that they are not necessary on LP's, simply because there is negligible scratch. Playback tone controls are necessary for the same reason that they are necessary with any amplifier input, namely that the program material varies enormously.

The subject of tone controls is a controversial one. Let it suffice, however, to say that the material fed to the recorder should have been pruned to an acceptable characteristic beforehand, and any adjustment to the response curve of the recorder itself should be merely to correct, as far as possible, any rise or fall with frequency, due to its inherent characteristics, over the required frequency range.

My experience with erase heads appears to have differed from Mr. Thomas'. With the high bias and erase frequencies I am in the habit of using, some difficulty was experi-

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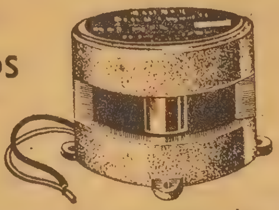

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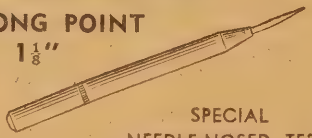

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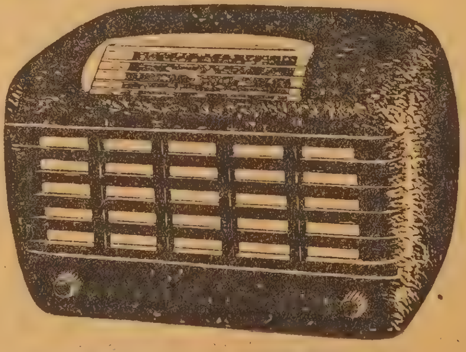

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I've seen precisely that circumstance arise.

So let's not be too impatient at the other fellow's approach. In a few years' time we may discover that neither of us knew much about it, anyway.

While thrashing this angle of "technical immaturity," let me suggest further that audio enthusiasts as a whole are still looking on tape machines as ultra-modern, semi-miraculous devices, to be judged by their own special standards.

If you're keen on instant-playback, hear-how-you-sound, dictate-your-letters-at-home, &c., then go on looking. It doesn't matter so much.

But, unless I am much mistaken, after the office and novelty needs have been met, the rest of us will begin to think of tape machines for what they really are — pieces of audio equipment. Then we'll begin to judge them by audio standards. I wonder how they'll fare?

HUM LEVEL

Take the simple matter of hum pickup in the head which seems to be the bugbear of just about every single-unit tape recorder I have ever handled.

Some hum audibly, others don't hum so much because the designers have trimmed the bass response.

But, tell me, how happy would you be with a regular domestic amplifier which hummed if you didn't cut out the bass? And, with big speakers in a quiet room, you don't need much hum to be annoying.

Then, again, sales people talk freely of "high fidelity reproduction," "tape quality," and so on.

But how seriously would you take a "Radio and Hobbies" amplifier if it purported to give high fidelity through a small cheap speaker, in a small plywood cabinet, driven by a single uncompensated pentode. That's the type of record player we begin to make excuses for.

No sir! Sales talk and goggle-eyed wonder will keep the tape market going for a while and there will always be a non-critical commercial demand. However, if the audio enthusiast is going to take tape decks seriously, they will simply have to meet the basic audio requirements of no audible hum, consistent flat response to at least 8 or 9 Kc., low distortion, and reasonable interchangeability of tapes from one machine to another.

To get down to the current argument, Thompson-v.-Thomas exception has been taken to the use of the heading, "Typical and Inexpensive Circuit," over the block on page 61 of the September issue.

THAT HEADING

Quite frankly, I was responsible for the said heading, my reaction being that the design lent itself to variations and omissions and to the parts-from-the-junk-box approach. A circuit which relies on the gain of a group of high-slope miniature tubes isn't so amenable to alterations. But the point must be conceded that, if you went along to buy a complete new kit of parts for the said amplifier, it wouldn't be cheap any more.

On the subject of triodes V pentodes and their ability to accept different orders of input signal, I'm afraid I must agree with Mr. Thompson's objections. There seems to have been some confusion of ideas and terms, to be sure, but Mr. Thomas did leave himself open to query in the way as the relevant paragraph was originally framed.

However, when it comes to the operation of a level indicator, my vote would have to go the other way—in favor of Mr. Thomas. The point is sufficiently important to warrant closer examination, not just in relation to tape recorders, but to accepted audio practice.

To avoid further possible confusion, let's start right back at the beginning, and with the people who use these devices to earn their daily bread.

In the production control room, the producer and control operator between them have certain important jobs to do:

THREE JOBS

(1) Maintain the program level at all times within the anticipated dynamic range of the channel, ie, between the overload and noise regions.

(2) Strike an acceptable dramatic balance between voice, music and sound effects.

(3) Keep the average program level sufficiently constant, subject to dramatic requirements, so that the listener does not need continually to alter the volume control setting of his receiver.

To achieve these ends, the said personnel have a monitor speaker connected to the program line which reproduced the program just as it will be heard by the ultimate audience. Any marked difference between the "monitor" and "audience" version of the program can only cause confusion.

Since the ear is a rather unreliable organ in judging volume level, the control personnel also have a volume indicating meter displayed prominently before them, which presents to the eye a reading of program loudness corresponding to the aural effect.

To achieve this end result, the meter must operate on a "power" basis (or volts across a constant impedance) and be no more frequency conscious than the speaker. In fact, specially damped "volume unit" meters are employed for the purpose and so arranged that they show the eye what the ear hears.

In a large studio installation, there is no complication about this, because the meter simply operates across the "flat" output line from the particular console. All sorts of equalisation may be applied subsequently to the signal for recording or transmission purposes, but this is not registered on the meter.

The whole system is pre-set so that, provided the control personnel obey the VU meter, nothing need be overloaded later in the chain.

If, for any special reason, it were necessary to operate the level indicator from a compensated line, the meter would need to be de-compensated by the reverse amount to make it give the kind of readings the operator needs.

DISC RECORDER

In simple recording outfits, everything is carried out on a much more elementary plane, but I don't think the basic truth of the foregoing paragraphs are affected — the indicator and loudspeaker monitor should both relate as closely as possible to the ultimate reproduced program.

In the case of our universal disc recorder, described some months ago, this very problem arose. Owing to the reactive nature of the recording head, the output volts rose steeply with frequency, though the power remained substantially constant.

To prevent meaningless and excessive output voltage readings on

THOMAS v. THOMPSON—Cont.

enced in getting complete erasure if the high-tension voltage was low. This trouble was completely overcome by tuning the erase head to the erase frequency by means of the feed capacitor.

The erase head may or may not resonate with the series capacitor at the oscillator frequency. With frequencies of between 30 and 40 Kc/s, sufficient current can usually be obtained even when it does not. If it does, the operation of the oscillator may be adversely affected; a series resistor will minimise this effect by damping the series resonant circuit.

When building a recorder, the relative positions of the motors and heads and the path of the tape are determined purely from mechaincal considerations which are stringent enough, anyway. For an amplifier designer, therefore, to sit back and say, "Put the head in the position of minimum hum," is a very isolationistic attitude. I have yet to see a satisfactory tape deck in which the position or direction of the playback head could be moved more than a fraction of an inch. It would be far better to describe methods of head shielding.

Anyone who sets out to build a recorder with a prearranged layout so cramped that the postion of heads and motors cannot be changed more than a fraction of an ich must be prepared to indulge in an orgy of shielding—and magnetic shielding, with which we are concerned, is not easy. Therefore, it is desirable to reduce the hum field as far as possible by choice of layout.

The position of the head is always a compromise; but the method of investigating the hum fields as described will avoid the exasperation of building a complete recorder and then discovering that the hum level is intolerable, even with a shielded head.

Unless the design is extremely compact, the capstan motor can be placed in several different positions with respect to the head, even if movement of the head with respect to the capstan itself is limited. The take-up motor is not so critical mechanically, and should be placed as far from the head as the layout will permit.

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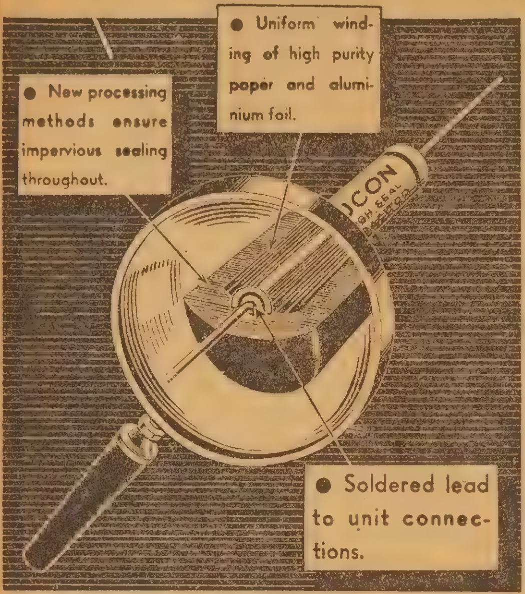
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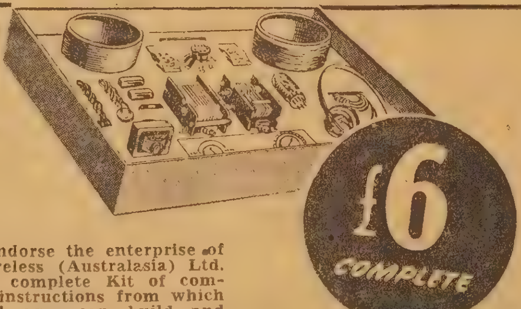

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treble notes and also a false, high-pitched reproduction from the monitor, both the meter circuit and the speaker voice coil circuit had to be severely "de-emphasised." I can assure you that the outfit is a much more pleasant and practical affair as a result.

A tape recorder is in precisely the same category, because the load is reactive and power is not proportional to output volts. If the monitor and output indicator operate from the head circuit, then they should be suitably compensated.

Whether or not an output indicator is necessary at all, of course, is partly a matter of taste and partly of application.

I don't think there can be any doubt that almost any properly adjusted output indicator is better than none in keeping tapes to a consistent recording level. But its reading must be interpreted always in terms of the particular tape on the machine.

It is also reassuring to be able to see something happening when you think you're recording! A tape machine without an indicator and used, perhaps by necessity, without a monitor speaker is a highly inanimate device.

PREVENT NOISE OR IGNORE IT?

A RECENT news item indicated that absorbent treatment, applied to the walls and floor of the Darlington (NSW) school for deaf children, had made possible a much higher degree of concentration. Previously, noises in the classroom, picked up and amplified by their hearing aids had proved most confusing. The absorbent treatment is to be applied to other classrooms.

The item is most significant to us folk who have been arguing recently about binaural hearing aids and the ability they confer to reject unwanted sounds. Had it been possible to instal a centralised binaural aid system, the costly sound-proofing would most likely not have been necessary.

There can be no doubt that a meter is the best indicator, followed by the twin neon idea and lastly the magic eye. You have to be careful with neons lest they load the circuit; magic eyes don't suffer this disability, but their pattern is hard to interpret with accuracy.

So much for all that. It seems, however, that the main point of argument between Messrs. Thomas and Thompson centres round this matter of constant voltage and constant current recording.

Mr. Thompson suggests that Mr. Thomas has missed the bus. Mr. Thomas seems rather uncertain whether he ever wanted to catch it.

I'm going to suggest that they're both partly right and both partly wrong. But it will take quite a lot of space to justify and explain this statement for which reason I plan to hold it over in toto till next month.

So, as they say in the weeklies, "watch out for our next big bumper issue."

FROM THE SERVICEMAN WHO TELLS

Maybe it's the number of old sets I've been handling lately or maybe it's just a sign of old age but, whatever the cause, I feel prompted this month to reminisce about the "good old days" and the circuitry which was current long before my younger readers took an interest in such things. In keeping with this theme there's a tip on the salvaging of an old type valve.

MY first case deals with the valve problem and since there are one or two other interesting aspects I will tell the whole story. The set was a rather old dual-wave set, featuring an RF stage, and which required a complete overhaul.

Main complaint was intermittent instability, any form of mechanical vibration being enough to send it off into violent oscillation which could only be cured by further doses of shaking or bashing. In addition, there was a really severe hum level and a refusal on the part of the volume control to control the volume completely.

CONTINENTAL VALVES

Some idea of the age of the set can be gained from the valve types, which were a Continental variety featuring four-volt filaments and a sprayed metal coating, which performed the function of a valve shield. This shield is normally earthed through one of the base pins, connection to the metallic paint being by means of a loop wire encircling the glass envelope just above the base.

This arrangement is perfectly satisfactory provided the glass envelope remains firmly cemented to the base but, should it come loose, as frequently happens, then trouble is inevitable. Once the glass moves away from the base there is very little mechanical support for the loop of wire and it soon parts company with the paint. The result is exactly the same as removing the shield from a valve and, if it happens to be a critical stage, the set will probably "take off."

This is exactly what had happened with this set, the offending valve being the IF amplifier. Due to the extreme touchiness of the complaint there was no trouble in finding it, it being quite an easy matter to start or stop the oscillation by moving the glass so that it either made or broke the connection to the earth loop. It also explained why the effect was intermittent, any mechanical vibration producing exactly the same effect.

HARD TO CURE

But it was one thing to find the trouble and quite another to decide on a satisfactory cure. The ideal solution, a new valve, was out of the question, this particular type being no longer available. A more modern type could have been substituted but the four-volt filament system made things awkward, there being little room to fit an auto transformer. There was also the additional objection of the cost of this component and the associated wiring modifications.

First I considered cementing the glass envelope to the base, without too much regard for the electrical efficiency of the joint, and then fitting a regular metal valve shield. This idea was abandoned when it was found almost impossible to mount a standard valve shield base in conjunction with the "P" base type socket, while less conventional methods of mounting would have been messy and inconvenient.

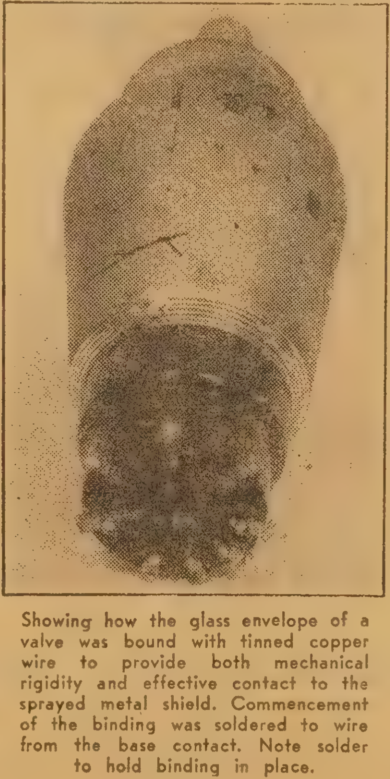
Next I considered the possibility of effectively repairing the wire-to-paint connection, a procedure which appeared to be justified, since the valve was showing normal emission and appeared to have much useful life ahead of it, in spite of its age.

I carefully unwound the earth wire from the envelope, cut it off about 1in from the base, cleaned it with fine emery, and tinned it. A certain amount of care needs to be exercised when handling this wire for, if it should be broken inside the base, it would be difficult to fit a new piece.

WIRE BINDING

Next I took a short length of 22 gauge tinned copper wire, straightened it by stretching, and soldered it to the earth wire. This was then bound around the glass envelope, forcing the first turn firmly against the top of the base. About six turns were made in all and the binding was made as tight as possible consistent with safety.

It was terminated by soldering to an adjacent turn and the solder was spread over the remaining turns. This was repeated at three other points on the binding and the joint finally given a coat of clear cellulose cement.


Showing how the glass envelope of a valve was bound with tinned copper wire to provide both mechanical rigidity and effective contact to the sprayed metal shield. Commencement of the binding was soldered to wire from the base contact. Note solder to hold binding in place.

This last step was really only an extra precaution because the wire binding alone made a really firm job, but it was, nevertheless, considered worth while and only required a few extra minutes' work. The electrical contact to the metallic spray was found to be excellent and when the valve was replaced in the set all traces of instability had vanished.

However, the socket showed signs of poor contact, producing crackles whenever the valve was moved or when the chassis was jarred. Some time was spent bending the contacts to increase the pressure, which improves matters considerably, but it then became clear that most of the other sockets were in a similar condition.

When all these had been treated in a similar manner most of the crackles and touchiness had disappeared, which I considered fortunate, because this type of socket is rather notorious for such troubles.

I know of one fellow-serviceman who maintains that often the only way to cure such crackles is to solder short lengths of fine tinned copper wire to each of the valve pins, thread these through the holes in the base of the socket, and solder them to the contacts!

DRASTIC MEASURES

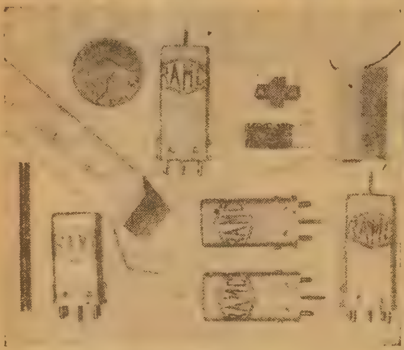
I'll admit it sounds drastic, but he maintains that it is generally much cheaper than fitting new sockets (assuming that these are available, which they frequently are not) and thus is a better proposition for a set whose future life is probably limited, anyway.

Provided the wire chosen is fine enough, it will break without doing any damage if the valve should be withdrawn from the socket by an unsuspecting serviceman, but it is really desirable that the owner be advised of what has been done, so that he may warn anyone else who may service the set.

However, no such drastic measures were needed on this set, and, having cured the crackles and oscillation, I turned my attention to the other faults. The hum was perfectly straight-forward, being simply the effects of old age on the electrolytics. There were three of these in the HT system, two in the main filtering section and one as part of a decoupling circuit to the converter stage.

Next problem was the minimum volume effect. This also turned out to be due to a faulty electrolytic, this time the 25 mfd. across the self-bias resistor in the diode detector and first audio stage. Since the

GOOD NEWS FOR SERVICEMEN



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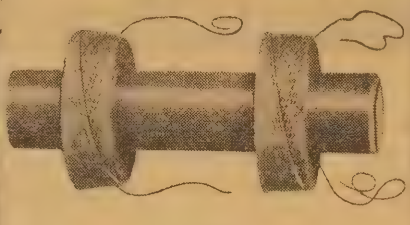

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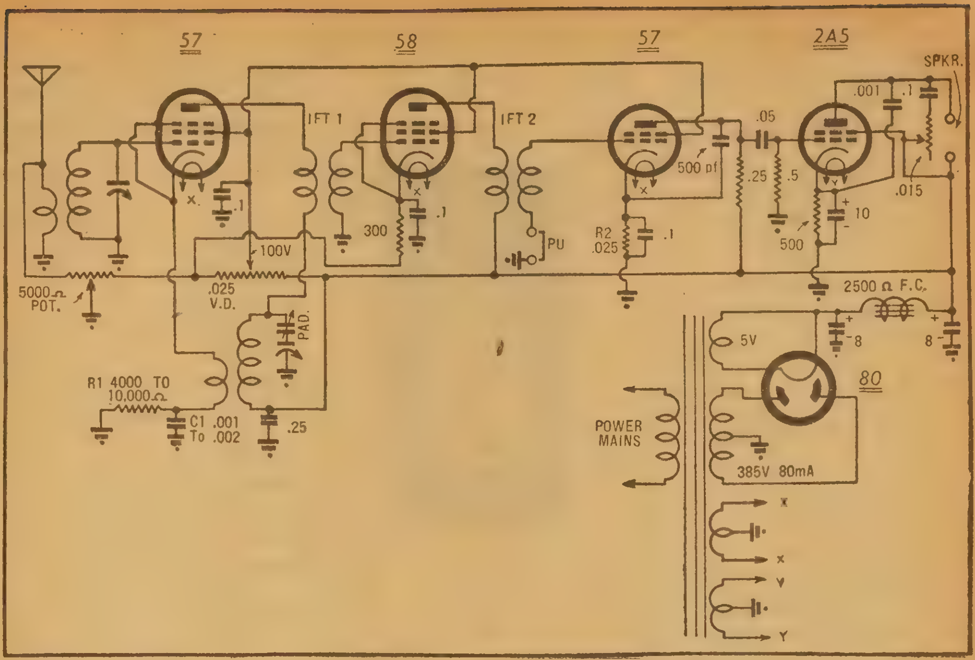
This circuit is typical of autodyne receivers popular in the days of 2.5 volt valves and the early superhets. Note the unusual oscillator-mixer circuit as compared to modern practice and the volume control in the 58 cathode circuit. The aerial connection to the other end of the volume control was popular method of increasing its effectiveness on strong signals, but was not a complete cure.



☆

"earthy" end of the diode load normally returns to the cathode rather than the chassis, it is essential that the cathode be at chassis potential as far as audio frequencies are concerned.

It is the job of the electrolytic by-pass to reduce the cathode-to-chassis impedance to a negligible amount at the lowest audio frequency to be handled, at the same time allowing the cathode to be maintained at the correct DC positive voltage for proper biasing. Failure of this electrolytic allows audio voltages to be developed across the self-bias resistor, and, even when the volume control is in the full-off position, these voltages are still present between grid and cathode.

QUESTION OF POLICY

A new electrolytic in this position cured the trouble, but raised another minor problem. Should I replace the remaining 25 mfd. electro. across the self-bias resistor of the output stage?

Actually, I could find nothing specifically wrong with it, at least not in the electrical sense, but it had every appearance of being just as old as the one I had just replaced. It was also suffering from a similar bulging at the ends, which may be taken as an indication of chemical processes in action, which the maker never intended.

Considering the costs already involved, it seemed rather risky to try to save a few shillings when it was most likely that this component would cause trouble within a few months. Far better to replace it now, when the extra cost would be little more than the price of the component, than to leave it to create a new—and more costly—service call at a later date.

With these more obvious faults eliminated, I began to take more critical notice of the set's general performance.

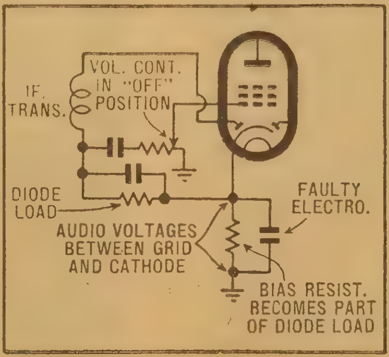
It was reasonably satisfactory on local stations, but did not seem to have the high sensitivity one usually associates with an RF stage, while the short-wave performance was only mediocre. Tuning across some of the local stations showed a lop-sided response which immediately suggested that the IF channel would only need to be correctly aligned to restore most of the lost sensitivity.

This, in fact, proved to be the case and, while not in itself an unusual fault, the point which struck me most was the difference in stability between the old "postage stamp" trimmers and the modern adjustable iron core. The latter are almost free from serious drift if properly sealed after adjustment, though the need for sealing is a point I have emphasised on previous occasions.

The final performance was extremely good on both the broadcast and short-wave bands, as one would expect from a set with an RF stage, and, since the owner was one of those rare persons who did use the short-wave section, he was very happy with the result.

SELECTIVITY PROBLEM

My next case was a rather unusual one and caused me to delve rather deeply into the history, not only of the set in question, but also of the owner's previous set. It all started with a service call for a minor defect (actually a faulty power cord) and when this was fixed the owner suggested that I might be able to do something to improve the selectivity.


VOL. CONT. IN "OFF" POSITION
IF. TRANS.
DIODE LOAD
AUDIO VOLTAGES BETWEEN GRID AND CATHODE
FAULTY ELECTRO.
BIAS RESIST. BECOMES PART OF DIODE LOAD

Showing how a faulty cathode by-pass electrolytic caused a "minimum volume" effect by allowing the cathode resistor to become part of the diode load with the cathode part way toward the hot end. Such a fault can also be expected to cause poor audio response and hum.

When I asked why he thought this characteristic of the set was poor, he replied that each station covered a much greater portion of the dial than the set which he had previously owned and that one station, a powerful local one, could be heard faintly as a background right up to the station on each side of it.

He proceeded to demonstrate both these effects and, while I could not refute his statement that the local station did spread badly, it was equally obvious that the so-called spreading of the stations was little different from any normal set.

The set was an old model and the valve line-up gave me the first clue to the story. The converter was a 2A7, the IF stage a 58, the detector a 2A6, and the power valve a 2A5.

In order to fully appreciate what this meant in the history of the set it is necessary to go back some years and trace some of the changes in set design in the earlier days. This may be of particular interest to the younger members of the community to whom autodynes and 2.5 volt valve types mean very little.

THE OLD DAYS

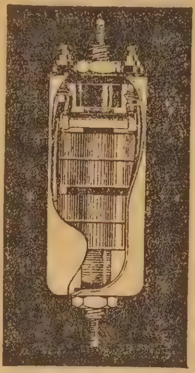
In the days of the first superhets (more years ago than I care to dwell upon!) a popular valve line-up was a 57 (a sharp cut-off pentode) as a combined oscillator mixer, a 58 (remote cut-off pentode) as an IF amplifier, another 57 as a biased detector, and a 2A5 as a power valve.

Wonderful as the performance was by the then accepted standards, they still had many disadvantages. Volume control was achieved by varying the bias on the IF stage, but this was seldom completely satisfactory because powerful local stations would still come through at an uncomfortably loud volume or else badly distorted if the bias on the 58 was pushed up in an effort to control things.

The real snag was that there was only one stage, the IF stage, which

"Q-PLUS" I.F. 1 & 2

MIDGET GENERAL PURPOSE I.F. TRANS.



Physical size—¾" x ¾" x 2".

Mounting—3-16" whit nut onto moulded insert in base—gummed paper template supplied.

Pin Connections—
P=Plate
G=Grid
B+ = B+
F=AVC

I.F. Frequency—455 Kcs.

Transformer Gain—
No. 1 10
No. 2 10

Winding L.—1.05 MH.
When tuned to 455 Kc.

Winding "Q"—120 in can.

Coupling Factor—1.F.1. .8k
I.F.2 9k.

Tuning Capacitor—100 uufd. silver mica.

REMARKS.

A general purpose midget 455 Kc I F. having abundant gain. No 1 for 1st position; No. 2 for 2nd. Silver plated terminal pins in non softening base. Carbonyl potted construction 5/41 litz wound. Negative temperature co-efficient condensers. Medium selectivity type.

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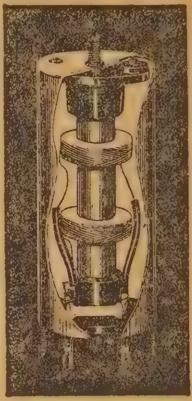
"Q-PLUS" I.F. 3 & 4

STANDARD GENERAL PUROPSE I.F. TRANS.



Physical Size—1 3-8" diam x 3".

Mounting—2 x 1-8" holes—1, 3-8" apart.

Pin Connections—
1=Grid
4=Plate
3=AVC, etc.
6=B+

I.F. Frequency—455 Kcs.

Transformer Gain—
No. 3 10
No. 4 10

Winding L.—1.05 MH.
When tuned to 455 Kc.

Winding "Q"—100 in can.

Coupling Factor. — I.F.3. — .8k. 1.F.4. 9k.

Tuning Capacitor—100 uufd. silver mica.

REMARKS.

A general purpose medium gain, I.F. 7/41 litz wound single pi construction No. 3, for 1st position; No. 4 for 2nd. N.B By using No. 4 I F. for the 1st position and again a No. 4 for 2nd position a broader bandwidth can be obtained. See graph.

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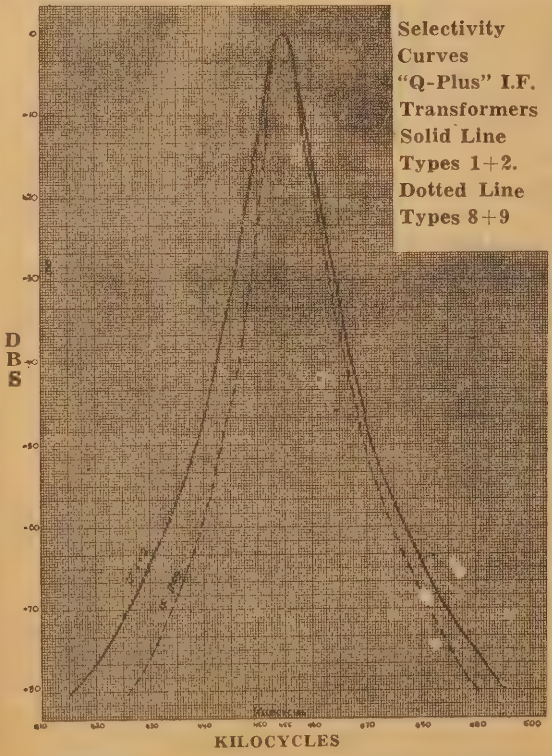

Selectivity Curves "Q-Plus" I.F. Transformers Solid Line Types 1+2. Dotted Line Types 8+9

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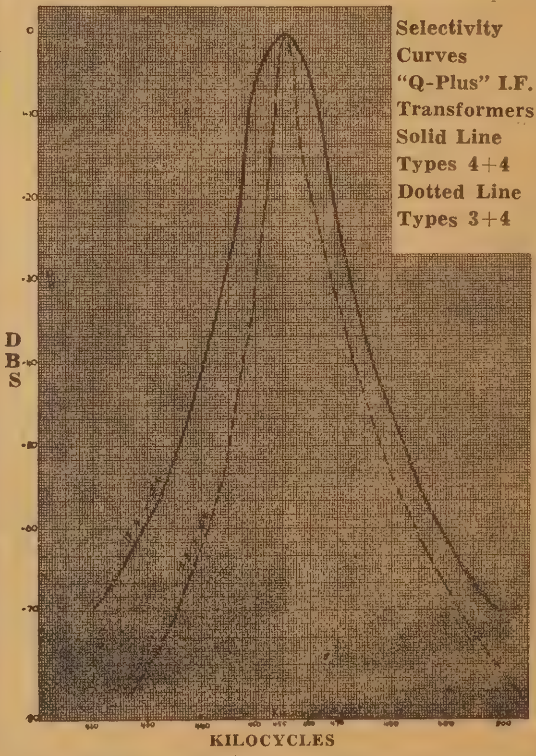

Selectivity Curves "Q-Plus" I.F. Transformers Solid Line Types 4+4 Dotted Line Types 3+4

R. W. STEANE & Co. Pty. Ltd., Auburn, Vic.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

the previous stage being dictated by the oscillator requirements.

Thus it was that most sets were fitted with some form of local distance switch which shorted, or partially shorted, the aerial to allow satisfactory reception of local stations. Considering the non-technical background of the average user, it is not surprising that this extra control was not always used correctly, and that the best performance of the set was not realised.

THE PENTAGRID

First major improvement was the introduction of the pentagrid converter, of which the 2A7 was a typical early type. This was really two groups of elements in the one envelope, oscillator and mixer.

By separating the two functions it was not only possible to provide more consistent and reliable oscillation, but also to control the gain of the mixer stage by means of variable bias in the same manner as the IF stage.

By this means powerful stations were easily controlled, even in difficult localities.

As far as I could make out it was this type of set which my customer had owned prior to his present one, and which he considered so much superior in the matter of selectivity.

No sooner had this type of set become standard practice than another new valve appeared, a triode with the addition of two diode plates in the same envelope.

Typical types were the 55 and the 2A6, the latter having a high gain triode section.

These altered the whole approach to the subject of detection and also made possible automatic volume control, or AVC as it is now called.

With the gain of the front end of the set taken care of automatically, engineers moved the manual control to the audio end, and produced a combination which would control virtually any signal, no matter how strong. They were well pleased with their efforts and, figuratively speaking, sat back, rubbed their hands in satisfaction, and considered that, for a time at least, their troubles were over.

CUSTOMER REACTION

But they had reckoned without the customer. Weaned from the diet of TRF's which spread a powerful signal half-way across the dial (well, nearly anyway), they had come to regard high selecticity as a major requirement. When the 175 Kc superhet appeared it was looked on as something almost miraculous, and many a tall tale was told by the proud owner of a new set, to prove just how amazingly selective his set was.

In other words, almost the entire radio listening population was selectivity conscious to the point of it being almost an obsession. Lacking any measuring equipment, there was only one way they knew to judge such selectivity, and that was to note how far a particular station spread across the dial.

Then the engineers, all unsuspecting, dropped a spanner, the AVC circuit, into the works. To the selectivity conscious multitude the result was completely unacceptable and they insisted that the AVC completely ruined the selectivity. Wasn't it obvious? Didn't stations now spread about four times further across the dial than that they did without AVC? Well, then, the selectivity must be worse!

Actually, of course, they failed to grasp the fact that the gain of set was being advanced as they detuned it, thus making the signal audible over a greater swing of the dial. That this did not represent a loss of selectivity was difficult to explain, particularly for the average non-technical salesman to the average non-technical customer.

But that was not the full story. There were cases where the older type sets had successfully separated stations in difficult localities, but where the new ones failed. And this was just the remaining evidence needed to clinch the impression that AVC ruined selectivity.

Actually, the real trouble was not the AVC circuit but the diode detector, which had come into being at the same time. This loaded the second IF transformer rather severely and, coupled with the air core, solid wire windings of moderate "Q," which were standard in those days, it was sufficient to produce an unfavorable performance in borderline cases.

Thus it was that, behind the purely fictitious loss of selectivity, there was a certain amount of truth in the listeners' claims. However, this was often completely overlooked by both salesmen and engineers in their efforts to convince customers that the AVC system did not cause a loss of selectivity.

Truly a case of two groups being at cross purposes.

BORDERLINE CASE

And where does my customer come into all this? Well, he was one of the borderline cases. His earlier set with the biased detector (and no AVC) had been just good enough to get by in his location but, when he traded it in for one of the (then) latest models with diode detection (and AVC), he was disappointed to find that separation was not so good the local station interfering with adjacent interstate stations.

Since I knew that modern sets had no trouble in eliminating the offending station, it seemed that the IF transformers, rather than the circuit, were at fault. first I checked them for alignment and as one would expect they had drifted quite a bit. However, the improvement was not sufficient to cure the trouble and it seemed that new IF transformers would be the only solution.

I explained this to the customer, gave him some idea of the cost, and drew his attention to the age of the set and the possibility that he may not consider the expense justified. This did not seem to worry him and he suggested that I go ahead with the alterations.

When these were completed and the set tested it provided a striking example of just how far coil designs have advanced since those early days, there being a most marked improvement in both gain and selectivity, to say nothing of the improved mechanical features and the greater ease of adjustment provided by the iron cores.

Finally, the set was tested in the customer's home. As I expected, there was now selectivity to spare and the customer was most gratified that he could now separate stations without having to sacrifice the very real convenience of AVC.

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CAN
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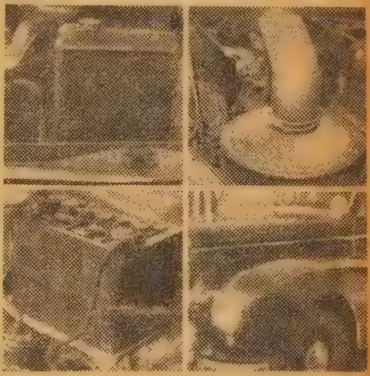
with the electric welding kit with thousand uses. Welds cracks and hol in car bodies, mudguards, radiators, e Repairs motor cycles, domestic app ances, sheet metal work, etc. It solds and brazes, too. Many useful artic can be made such as Station Wag Bodies, Radio Chassis, Caravan Bodi etc.

The kit is easy to operate and it quick pays for itself in time and money save Works from 6 volt or 12 volt batte Call in for free demonstration of weldi or send now for this complete weldi tool, 10 ft of welding cable and 3 batte clips, assortment of welding rods, flu electrodes, and complete working instru tions.



This welding kit is the only on sold in Australia with a 6-poi guarantee.

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Enclosed is £4/15/6. Please send me complete Welding Kit and six-point guarantee. If at the end of 14 days I do not wish to keep it. I will return it in good order, and you will refund my £4/15/6 in full.

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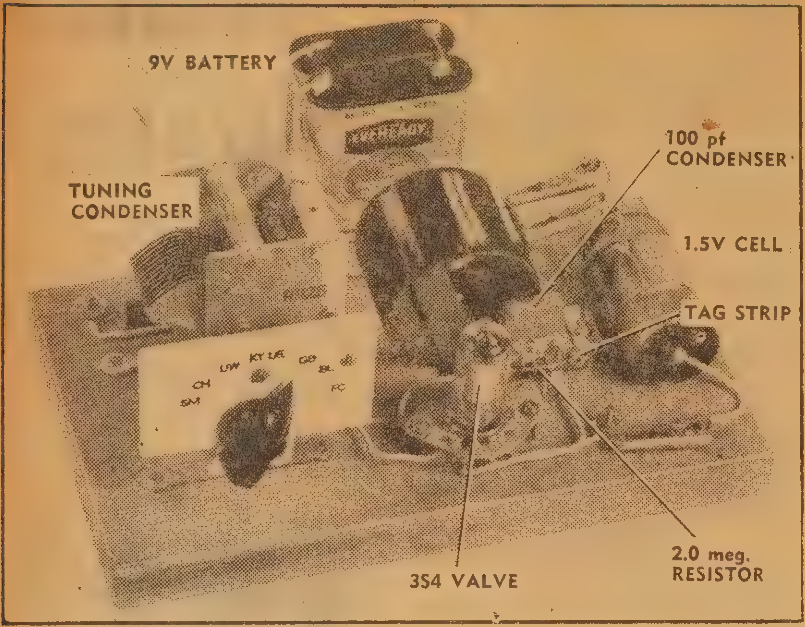
Please write name and address in BLOCK LETTERS.



The building of this new set will help you understand quite a number of important things about valves. The valve here is used as an amplifier so that signals will be louder than with the crystal set or last month's receiver.

Teach Yourself Radio (4)

MAKING THE SIGNALS LOUDER

Theory and practice go hand in hand again this month as we progress from simple diode valves to triode and tetrode amplifiers. No longer need we depend on the energy picked up by the aerial to operate the headphones. Results are vastly improved over last month's set and in building the new set you learn many of the important principles of radio.

by Maurice Findlay

YOU will remember last month we introduced you to a diode valve and explained how it worked and how it could be used in a radio receiver. The receiver described last month used a diode valve in place of the crystal detector of the simple receiver described in the September issue. With the filament dry cell connected, you were able to tune in signals in just the same way as with the crystal detector.

EARLY EXPERIMENTS

The first valves were used in just this way. Fixed crystal detectors of the type we used in our first receiver were not obtainable until a few years ago. The valve therefore, had the great advantage that it did not require a critical adjustment and furthermore its operation was not disturbed by a slight bump as is often the case with an ordinary adjustable crystal.

To extend the range over which radio signals could be sent and received, more powerful transmitters were built together with larger aerials and an effort was made to make the headphones as sensitive as possible.

A considerable amount of time was spent in trying to improve the efficiency of the detector. Various types of natural minerals were tried with varying degrees of success. Some were better than others but the fundamental limitation still applied: the only power available to drive the headphones was that which was collected by the aerial.

It is a great tribute to the patience and skill of such men as Marconi that signals were able to be sent over long distances with such primitive equipment.

The diode valve, which was invented by Edison and later applied to radio by an Englishman named Fleming, was a step in the right direction. Although it did obviate the need for adjustment and thereby make radio equipment more reliable, it did not make the signals any stronger.

The discovery which brought about a really worthwhile improvement was the three element, or triode, valve. For this we are indebted to a number of clever men, the most prominent of whom was an American called Lee DeForest.

He discovered that, if a fine wire mesh or a fine spiral of wire were placed around the filament between the filament and plate, it could be made to have a very wide control over the number of electrons flowing between the filament and plate.

REVOLUTIONARY DISCOVERY

The third element is called the "control grid," or simply the "grid." If a battery is connected so as to make it negative with respect to the filament, it tends to repel the electrons back to the filament. As a result the plate current is reduced or, if the negative voltage applied to the grid is sufficiently great, the plate current is prevented from flowing altogether.

On the other hand, if the battery be connected so as to make the grid positive with respect to the filament the electrons will be attracted toward it. Some of them will be collected by the grid and a meter connected in the grid circuit will read a small amount of current.

However, most of the electrons will have acquired such a high velocity that they will go straight through the spaces in the grid to be finally collected by the plate. In other words, the main effect of making the grid more positive is to increase the plate current.

The best way to illustrate the behavior of a triode valve is by means of graph. If the valve is wired to the circuit shown in Fig 1 the plate current at various grid voltages can be found. For example, with a 25-volt plate supply and a grid voltage of minus 6 the plate current is almost zero. When the grid voltage is zero and with the same plate voltage, the plate current is about 4½ mA, while increasing the grid voltage to plus 6, with respect to the filament increases the plate current to about 16 mA.

(Continued on Page 55)

TELEPHONES: JA2877, JA2878 **FERGUSON LANE, CHATSWOOD**

STANDARD -FERGUSON- RANGE

RECEIVER POWER TRANSFORMERS

CODE No.	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS	RETAIL PRICE
PF185	240	150	30	6.3V/2A	43/11
PF299	240	285	40	6.3V/2A, 5V/2A	43/11
PF300	240	325	40	6.3V/2A, 5V/2A	45/6
PF201	240	225	50	6.3V/2A	44/8
PF151	200, 230, 240	285	60	6.3V/2A, 5V/2A	53/1
PF166	200, 230, 240	325	60	6.3V/2A, 5V/2A	54/-
PF165	200, 230, 240	385	60	6.3V/2A, 5V/2A	58/3
PF170	200, 230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A	60/10
PF169	200, 230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A	62/4
PF168	200, 230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A	65/5
PF130	200, 230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A	67/6
PF164	200, 230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A	69/-
PF160	200, 230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A	76/5
PF152	200, 230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A	85/4
PF163	200, 230, 240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A	86/10
PF181	200, 230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A	95/8
PF174	200, 230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A	89/8
PF142	200, 230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A	96/7
PF175	200, 230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A	111/11
PF173	200, 230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A	173/3
PF140	200, 230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A	162/2
PF171	200, 230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A	213/3

POWER AMP. AND LOW POWER TRANSMITTER UNITS

PF159	220, 240, 260	475	175	6.3V/4A, 6.3V/2A, 5V/3A	188/9
PF172	200, 230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A	213/3
PF143	200, 230, 240	600 500	200	2.5V/5A, 2.5V/5A, 5.5V/.5A	236/1
PF147	200, 230 240, 260	1000 750 500	200 250 300	5.5V/.3A	292/10
PF179	200,230, 240	475	225	6.3VCT/4A, 6.3V/2A, 5V/3A	183/1
PF107	230, 240	585	250	6.3V/3A, 6.3V/2.5A, 5V/3A	224/10
PF176	200, 230, 240, 260	1250	300	6V/.3	449/9
PF177	200, 230, 240, 260	1830, 1100	300	6V/.3A	Price on request

VIBRATOR AND A.C. POWER TRANSFORMERS

PF182	240AC 12VIB	200	40	12.6V/1A	53/10
PF122	240AC 6VIB	220	40	6.3V/2A	54/-
PF125	240AC 6VIB	250	60	6.3V/2A	63/-
PF126	240AC 12VIB	250	60	12.6VCT/1A	63/-
PF119	240AC 6VIB	325	125	6.3V/4A	89/10
PF146	200, 230. 240 AC, 12, VIB	325	150	12.6VCT/2.5A	105/9

VIBRATOR TRANSFORMERS

CODE	PRIM.	DC OUTPUT		BUFFER		RETAIL
NR	VOLTS	VOLTS	mA	Full Sec.		PRICE
VT100	32	200	40	.005		44/6
VT101	6	90	15	.008		34/10
VT102	6	150	25	.005		40/9
VT103	6	200	50	.005		42/11
VT104	6	250	60	.005		43/11
VT105	12	250	60	.005		45/6
VT106	6	300	75	.008		72/7
VT107	6	250	60	.005	Low Radiation	48/1
VT108	12	90	15	.008		36/3
VT109	24	90	15	.008		38/4
VT110	12	150	25	.005		42/11
VT111	24	150	25	.005		47/-
VT112	12	200	50	.005		45/-
VT113	24	200	50	.005		45/-
VT114	12	300	75	.008		78/2
VT115	24	300	75	.008		79/-
VT116	24	250	60	.005		50/1
VT117	12	250	60	.005	Low Radiation	48/6
VT119	32	150	25	.005		40/8
VT121	6	180	30	.005		45/-
VT122	6	400	50	.005		73/4
VT123	12	320	125	.005		94/5
VT124	32	250	60	.005		49/1
VT127	6	200	50	.005	Low Radiation	45/-
VT128	12	250	60	.005	Low Radiation	53/1
VT146	6 or 12	240AC	50W	1MFD.	For emergency light, etc.	64/2

POWER CHOKES

CODE No.	IND. HY.	DC RES	DC mA	RETAIL PRICE
CF100	50	1900	10	29/6
CF101	30	870	25	28/9
CF102	15	300	60	22/5
CF103	30	420	60	42/2
CF104	30	580	75	44/10
CF105	15	250	80	37/9
CF106	12	200	100	38/2
CF107	30	360	100	51/9
CF108	12	135	150	53/11

CODE No.	IND HY	DC RES	DC mA	RETAIL PRICE
CF109	20	225	150	56/4
CF110	12	100	200	65/5
CF111	16	165	200	65/5
CF112	10	70	250	65/5
CF113	.5/20	70	250 50	72/1
CF114	1.1	23	375 AC	44/10
CF115	.017	.6	2A	19/8

GRID INPUT TRANSFORMERS

CODE	MATCHING		NOM. IMPEDANCE		MAX.		RETAIL
No.	FROM	TO	PRIM.	SEC.	WATTS		PRICE
MT104	Mike, P.U.	Grid	3.7, 50	50,000			44/10
MT105	Mike, P.U.	Grid	3.7, 50	60,000			164/1
MT108	Line	Grid	120	1200			98/11
MT109	Cath.	Grid	100	1000			56/2

LINE TRANSFORMERS

MT100	Line	Spkr.	600	4, 3	15		56/2
MT101	Line	Spkr.	500	15	15		56/2
MT124	Line	Spkr.	600 500	4, 3, 2.7 2.3, 2.	25		94/5
MT125	Line	Spkr.	600 500	15, 12.5 8.4, 6.5	25		92/2
MT111	Line	Spkr.	500	12.5, 8 2.3	10		60/7

MODULATION TRANSFORMERS

MT118	Audio Amp	Class C Amp	8000 6000 P.P.	10,000 7000 5000	25		148/6
MT119	Audio Amp	Class C Amp	8000 6600 3800 P.P.	10,000 7500 6500 5500 4500 3500	50		171/-
MT120	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	50		312/7
MT121	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	125		384/10

DRIVER TRANSFORMERS

MT106	Class A Driver S.E.	Class AB1 Grids	5000 Step Up 1:5 Pri. DC 40 mA	125,000	5		98/-
MT107	Class A Driver HI. MU. S.E.	Class A Grids P.P. or S.E.	10,000 Step Up 1:3	90,000	1		143/-
MT112	Class A Driver HI. MU. S.E.	Class A Grids P.P. or S.E.	10,000 Step Up 1:2 5 mA DC unbalance	40,000	.5		89/11
MT113	Class A Driver S.E.	Class AB2 Grids	5000 Step Down 1.25:1 40 mA Pri. DC	3200	2		106/11
MT114	Class A Driver P.P	Class B Grids	5000 Step Down 1, 1.5 or 2	5000 2200 1250	5		122/7
MT115	Class A Driver P.P. or S.E.	Class B Grids	5000 Step Down 1.07 or 1.4 40mA DC max unb.	4400 2500	5		122/7

FILAMENT TRANSFORMERS

CODE No.	PRIM. VOLTS	SEC. VOLTS	RETAIL PRICE
PF117	240	2.5V/.3A.	29/1
PF118	220, 240, 260	2.5V/5A, 2.5V/5A.	50/9
PF158	220, 240, 260	5V/8A.	56/2
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A.	79/9
PF162	240	6.3V/3A, 6.3V/3A.	58/8
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A, 5V/3A, 2.5V/7A	168/8
PF102	240	7.5V/2A.	42/8
PF111	240	10V/5A	60/4
PF131	230, 240	10VCT/10A, 5V/15A.	179/11

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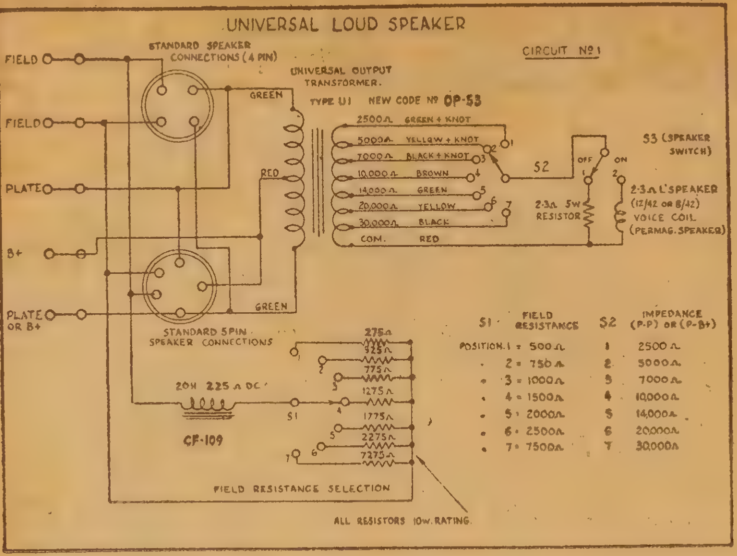
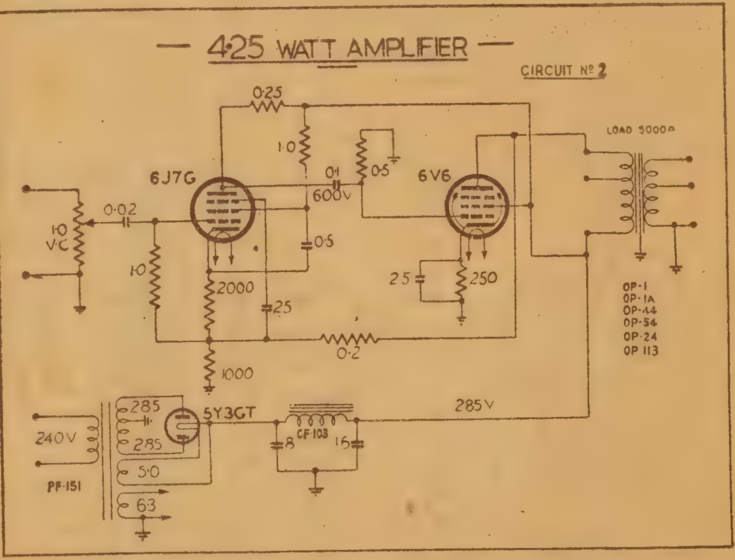
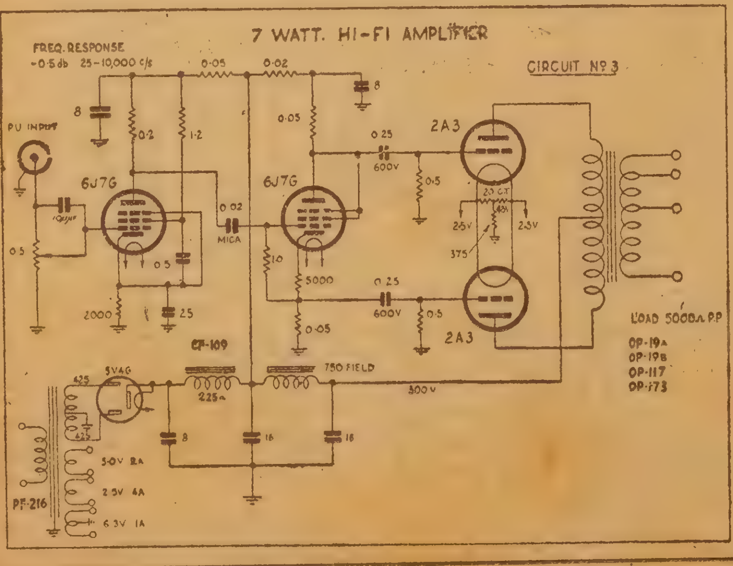
SEE BACK OF THIS SHEET FOR FULL


UNIVERSAL LOUD SPEAKER
CIRCUIT No 1
FIELD
FIELD
PLATE
B+
PLATE OR B+
STANDARD SPEAKER CONNECTIONS (4 PIN)
UNIVERSAL OUTPUT TRANSFORMER.
TYPE U1 NEW CODE No OP-53
GREEN
RED
GREEN
2500Ω GREEN + KNOT
5000Ω YELLOW + KNOT
7000Ω BLACK + KNOT
10,000Ω BROWN
14,000Ω GREEN
20,000Ω YELLOW
30,000Ω BLACK
COM. RED
S2
OFF ON
S3 (SPEAKER SWITCH)
2·3Ω 5W RESISTOR
2·3Ω L'SPEAKER (12/42 OR 8/42) VOICE COIL (PERMAG. SPEAKER)
STANDARD 5 PIN SPEAKER CONNECTIONS
20H 225Ω DC
CF-109
S1
275Ω
325Ω
775Ω
1275Ω
1775Ω
2275Ω
7275Ω
FIELD RESISTANCE SELECTION
ALL RESISTORS 10W. RATING.
S1 FIELD RESISTANCE
POSITION 1 = 500Ω
2 = 750Ω
3 = 1000Ω
4 = 1500Ω
5 = 2000Ω
6 = 2500Ω
7 = 7500Ω
S2 IMPEDANCE (P-P) OR (P-B+)
1 2500Ω
2 5000Ω
3 7000Ω
4 10,000Ω
5 14,000Ω
6 20,000Ω
7 30,000Ω


— 4·25 WATT AMPLIFIER —
CIRCUIT No 2
0·25
1·0
01 600V
05
6J7G
6V6
LOAD 5000Ω
1·0 V·C
0·02
0·5
1·0
2000
25
25
250
0·2
1000
OP-1
OP-1A
OP-44
OP-54
OP-24
OP 113
240V
285
285
5·0
6·3
PF-151
5Y3GT
CF-103
8
16
285V


7 WATT. HI-FI AMPLIFIER
CIRCUIT No 3
FREQ. RESPONSE -0·5db 25-10,000 c/s
PU INPUT
8
0·2
1·2
0·05
0·02
8
0·05
6J7G
6J7G
0 25 600V
0·5
2A3
2A3
0·02 MICA
0·5
0·5
1·0
5000
25V
25V
375
0 25 600V
0·5
0·05
2000
25
CF-109
LOAD 5000Ω P.P
OP-19A
OP-19B
OP-117
OP-173
5V4G
425
425
225Ω
750 FIELD
300V
8
16
16
5·0V 2A
2·5V 4A
6·3V 1A
PF-216

Telegrams and Cables:
"FERTRAN,"

-FERG

TRANSFORM

In reply to many requests, we

circuits which were featured severa

The circuits have stood the t

proved thoroughly reliable over a p

CIRCUIT No. 1 illustrates the use of a s
for a Universal Test Loud Speaker, as u
Recommended Types: Filter Choke CF
previously Type U1.

CIRCUIT No. 2 illustrates a low power
able for home listening.
Recommended Types; Power Transfor
Transformer OP-54, OP-44, OP-1, OP-1

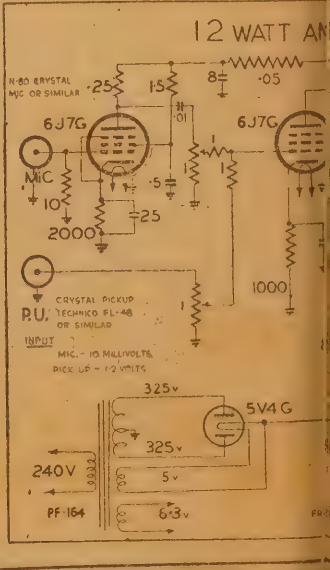
CIRCUIT No. 3 Special Output Transfo
providing the utmost fidelity.
Recommended Types: Power Trans
Transformer OP-19A or OP-19B, OP-1
response the following types may be u

CIRCUIT No. 4 is a 12 Watt Amplif
designed for Public Address work.
Recommended Types: Power Transfor
Transformer MT 112, previously Typ
OP-4, OP-5, OP-8, OP-9, or OP-58.

CIRCUIT No. 5 is a small P.A. Ampli
transformer.
Recommended Types: Power Transfor
Transformer MT 112, previously Type

CIRCUIT No. 6 illustrates a Medium
Amplifier may be used as a low power
type of Output Transformer used.
Recommended Types: Power Transfor
Transformer MT 112, previously Type
OP-15 or M50, M50M.

CIRCUIT No. 7 illustrates a High Powe
Class AB2 Driver Transformer.
Recommended Types; Power Transfor
Chokes CF 112. CF 107; Driver Transf
Transformer OP-18, OP-61 or M50, M5


12 WATT AM
N-80 CRYSTAL MIC OR SIMILAR
·25
1·5
8
·05
6J7G
6J7G
·01
MIC
·5
1
10
25
2000
1000
CRYSTAL PICKUP TECHNICO FL-48 OR SIMILAR
P.U.
INPUT
MIC. - 10 MILLIVOLTS
PICK UP - 1·2 VOLTS
325v
5V4G
325v
5v
6·3v
240V
PF-164

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timatch Output Transformer OP-53,

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151; Filter Choke CF 103, Output
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ave been developed for this circuit,

PF 216; Filter Choke CF 109; Output
173 with slightly lower frequency
55, OP-34, or OP-6.

g the minimum number of valves,

164; Filter Choke CF 106; Driver
Output Transformer OP-57, OP-8M,

ample gain using a special driver

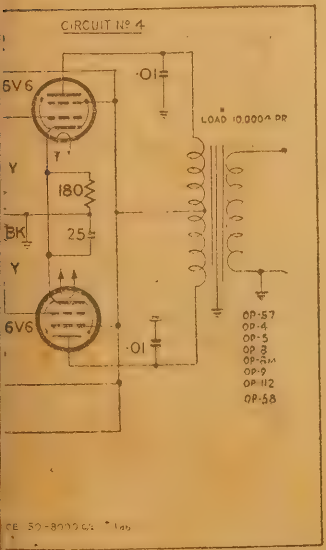
142; Filter Choke CF 109; Driver
utput Transformer OP-10 or OP-59.

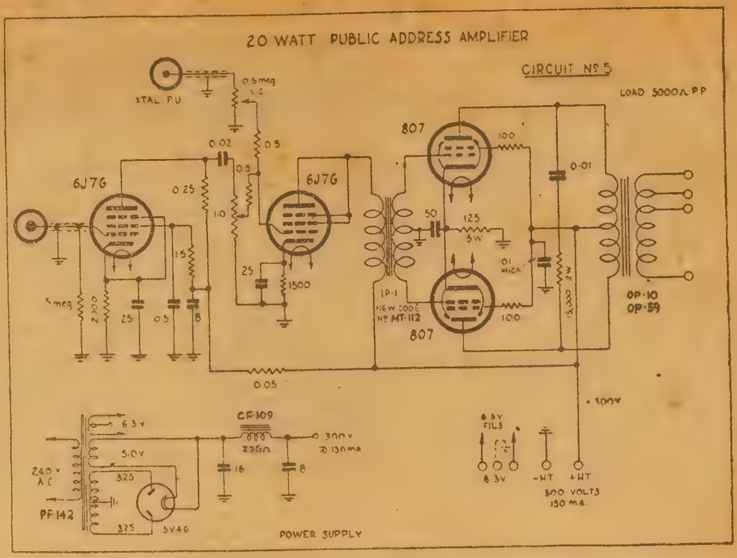
P.A. Amplifier or Modulator. This
or or P.A. Amplifier depending on the

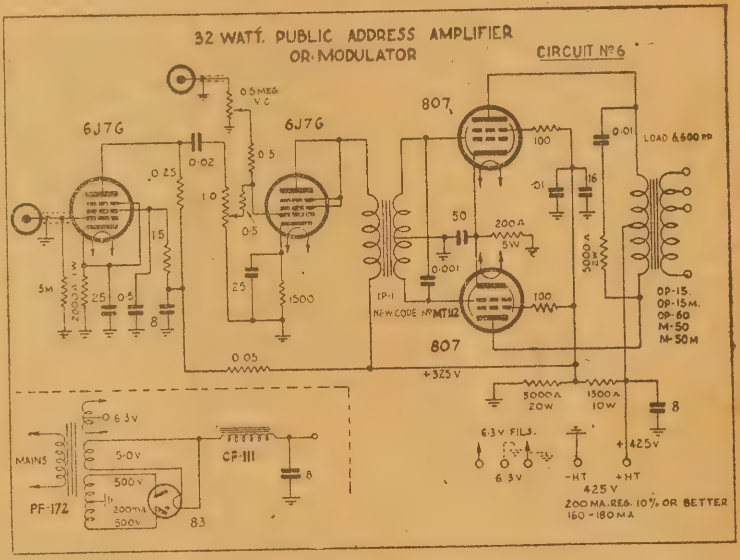
172; Filter Choke CF 111; Driver
Output Transformer OP-15M, OP-60,

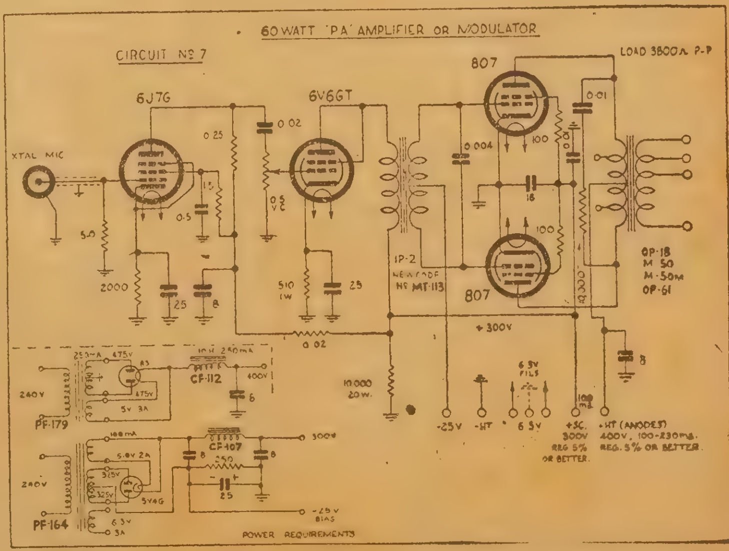
mplifier or modulator using a special

179 (475V), PF 164 (325V); Filter
IT 113, previously Type IP2; Output


CIRCUIT Nº 4
6V6
·01
LOAD 10,000Ω PP
Y
180
BK
25
Y
6V6
·01
OP-57
OP-4
OP-5
OP 8
OP-8M
OP-9
OP 112
OP-58
CE 50-8000 C/S


20 WATT PUBLIC ADDRESS AMPLIFIER
CIRCUIT Nº 5
XTAL PU
0.5 meg VC
LOAD 5000Ω PP
807
6J7G
0.02
0.5
6J7G
0.25
1.0
100
0.01
50
125 5W
·01 MICA
5 meg
2000
25
0.5
8
1500
25
1.5
IP-1 NEW CODE Nº MT-112
807
100
15,000 2W
OP-10
OP-59
0.05
+300V
CF-109
6.3V
5.0V
325
325
240V AC
PF 142
5V4G
220Ω
16
8
300V @ 130mA
6.3V FILS
6.3V
-HT
+HT
300 VOLTS 130 mA
POWER SUPPLY


32 WATT PUBLIC ADDRESS AMPLIFIER OR MODULATOR
CIRCUIT Nº 6
0.5 MEG VC
807
6J7G
6J7G
0.02
0.25
0.5
1.0
0.5
100
0.01
LOAD 6,600 PP
·01
16
50
200Ω 5W
0.001
5000Ω 2W
5M
2000Ω
25
0.5
8
1.5
25
1500
IP-1
NEW CODE Nº MT112
100
807
OP-15
OP-15M
OP-60
M-50
M-50M
0.05
+325V
5000Ω 20W
1300Ω 10W
8
6.3V
5.0V
500V
200mA
500V
MAINS
PF-172
CF-111
8
83
6.3V FILS
6.3V
-HT
+HT
+425V
425V
200 MA REG. 10% OR BETTER
160-180 MA


60 WATT 'PA' AMPLIFIER OR MODULATOR
CIRCUIT Nº 7
LOAD 3800Ω P-P
807
6J7G
6V6GT
0.01
0.25
0.02
0.004
100
XTAL MIC
5.0
0.5
1.5
0.5 VC
18
100
IP-2
NEW CODE Nº MT-113
2000
25
8
510 1W
25
807
OP-18
M 50
M-50M
OP-61
+300V
0.02
250mA 475V
83
475V
5V 3A
10H 250mA
CF-112
400V
6
240V
PF-179
10,000 20W
8
100mA
5.0V 2A
325V
325V
5V4G
CF-107
250
8
8
25
300V
240V
PF-164
6.3V 3A
-25V BIAS
POWER REQUIREMENTS
-25V
-HT
6.3V FILS
6.3V
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Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
10	5000, 2500 SE	12.5, 8, 2.3	64/3		OP-1
10	5000, 2500 SE	5, 2.7	65/4		OP-33
10	5500 SE	3.7	72/1		OP-41
10	30,000 20,000 14,000 10,000, 7000, 5000, 2500 PP	2.3	65/2	Universal Test Loud Speaker	OP-53
10	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	72/1		OP-54
10	5000, 2500 SE	15.	65/4		OP-39
10	10,000 PP	15, 8.4, 2.3.	72/1	5W Cath Amplifier	OP-85
10	7000 PP	Any ONE of following impedances—15, 12.5, 8.4, 2.3, 2.	72/1	9W Cath Amplifier	OP-92
15	5000 PP	12.5, 8, 2.3.	99/1		OP-2
15	6600 PP	12.5, 8, 2.3.	99/1		OP-3
15	10,000 PP	12.5, 8, 2.3.	99/1		OP-4
15	10,000, 6600, 5000 PP	12.5, 8, 2.3.	99/1		OP-5
15	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	105/6		OP-55
15	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	105/6		OP-56
15	10,000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	105/6		OP-57
15	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	106/8		OP-58
25	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	133/10		OP-59
32	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	171/-		OP-60
60	3800 PP	17.6	166/8		OP-36
60	3800 PP	100, 75, 50, 25, 10, 5, 2.	195/5		OP-61

P.A. RANGE 50-8000 cps. Output to Line

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
10	5000, 2500 SE	500	64/3		OPIA
10	5000, 2500 SE	500, 250, 125	74/3		OP-44
15	5000 PP	500, 250, 125	99/1		OP-6
15	6600 PP	500, 250, 125	99/1		OP-7
15	1000 PP	500, 250, 125	99/1		OP-8
15	10,000 PP	500, 250, 160, 125, 100, 83.5, 71.5, 62.5, 55.5, 50	117/4		OP-8M
15	10,000, 6600, 5000 PP	500, 250, 125	99/1		OP-9
15	5000 PP	600, 300, 200, 150, 130, 100, 75, 50	114/10		OP-34
15	8000 PP	600, 300, 120, 60, 30	199/10		OP-50
25	5000 PP	500, 250, 125	119/7		OP-10
25	6600 PP	500, 250, 125	119/7		OP-11
25	10,000 PP	500 250, 125	119/7		OP-12

P.A. RANGE Cont.

Wts	Primary Impedance	Secondary Impedance	Price Retail	Special Application	Code No.
25	10,000, 6600, 5000 PP	500, 250, 125	119/7		OP-13
25	10,000 6600 PP	500, 4000, 8.4, 2.2	164/1	Cutting and Playback Amplifier	OP-35
25	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5,3.6,2.7	199/10		OP-38
32	5000 PP	500, 250, 125	144/11		OP-14
32	6600 PP	500, 250, 125	144/11		OP-15
32	6600 PP	500, 250, 166, 125, 100, 83. 5,71.5, 62.5, 55.5, 50	148/9		OP-15M
32	10,000 PP	500, 250, 125	144/11		OP-16
32	10,000, 6600, 5000 PP	500, 250, 125	144/11		OP-17
32	6600 PP	140, 70	171/-		OP-48
60	3800 PP	500, 250, 125	168/8		OP-18
60	3800 PP	100, 75, 50, 10, 5, 2	195/5		OP-61
80	6400 PP	500, 250, 125	207/-		OP-37
105	8800,6000 PP	500	299/-		OP-49
150	11,600 8400 PP	500, 250, 166, 125	384/1		OP-20

HI-FI RANGE 30-15000 cps. Output to Voice Coil

Wts	Primary Impedance	Secondary Impedance	Price Retail	Special Application	Code No.
5	5000 SE	Any ONE of the following impedances 15, 12.5, 8.4, 6.5, 2.1	67/6	4W Baby Playmaster	OP-24
10	3250 SE	12.5, 8.4, 2.3	101/2	R & H Vox Major	OP-23
10	5000 SE	2	92/-	For Rola 120x Speaker	OP-113
10	5000 PP	2	92/-	For Rola 120x Speaker	OP-117
10	6600 PP	2	92/-	For Rola 120x Speaker	OP-119
10	8000 PP	2	92/-	For Rola 120x Speaker	OP-118
10	10,000 PP	2	92/-	For Rola 120x Speaker	OP-112
15	5000 PP	12.5, 8, 2.3	147/2		OP-19A
15	10,000 PP	15, 3.75	152/11	10W Playmaster	OP-63
15	10,000 PP	12.5, 3.125	152/11		OP-64
15	10,000 PP	8.4, 2.1	152/11		OP-65
20	4500 PP	15.5, 12.5, 8.6, 2.7, 2	134/4	15 & 32W Cathamplifiers	OP-51

Output to line

Wts	Primary Impedance	Secondary Impedance	Price Retail	Special Application	Code No.
10	3250 SE	500, 250, 125	101/2		OP-22
15	5000 PP	500, 250, 125	147/2		OP-19B
15	10,000 PP	500, 125	152/11		OP-62

SPECIAL HI-FI RANGE 20-30,000 cps.

Wts	Primary Impedance	Secondary Impedance	Price Retail	Special Application	Code No.
15	10,000 PP	8.4, 2.1	180/11	For Williamson Amp.	OP25/8.4
15	10,000 PP	10, 2.5	180/11	For Williamson Amp.	OP25/10
15	10,000 PP	12, 3	180/11	For Williamson Amp.	OP25/12
15	10,000 PP	15, 3.75	180/11	For Williamson Amp.	OP25/15
15	10,000 PP	16, 4	180/11	For Williamson Amp.	OP25/16
15	10,000 PP	40, 10	180/11	For Williamson Amp.	OP25/40
15	10,000 PP	250, 62.5	180/11	For Williamson Amp.	OP25/250
15	10,000 PP	500, 125	180/11	For Williamson Amp.	OP25/500
15	5000 PP	8.4, 3.7	192/5		OP-66
15	5000 PP	15, 6.5	192/5		OP-67

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(Continued from Page 50)

HOW RADIO VALVES AMPLIFY

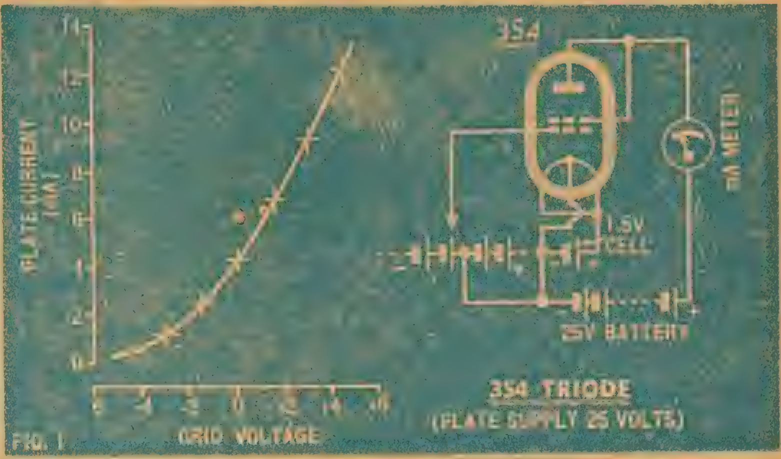


FIG. 1

With the aid of a meter and some dry cells you can plot the characteristic curve of a triode valve. A negligible amount of power in the grid circuit is able to control a large amount of power in the plate circuit. Thus, energy from the batteries is able to drive the headphones.

If you adjust the grid voltage in eps of 1½ volts from minus 6 to lus 6 and note the corresponding late currents as read on the meter, ou will obtain a series of points n the graph. A smooth curve, simiar to the one shown can then be rawn through the points. From this urve, you can determine the plate urrent with different grid voltages.

There is no need to limit your nvestigation to the 25-volt plate upply. Much the same may be done vith any other supply voltage proided it is less than the maximum ermitted by the manufacturers, in his case 67.5 volts. The manufacurers also set a limit on the plate urrent which the valve may be pernitted to draw so that if you use high voltage plate supply the grid nust be kept negative in order that t not be exceeded.

If the manufacturer's limitation is xceeded, the filament may be called ipon to emit a greater number of lectrons than it is safely able and he valve may be permanently damged. We take great care in designng all Radio and Hobbies circuits o see that these limits are not exeeded.

AMPLIFIER CIRCUIT

Instead of the meter, a pair of headphones may be connected in the plate circuit of the valve and will respond to quick variations in the plate current to produce sound. If now, instead of connecting the grid circuit to a battery, as we did before, we connect it to a source of voltage varying at audio frequency, an amplified version of the original signal will be heard in the headphones.

The valve, wired as shown in Fig. 2, can be connected to a crystal detector or a diode detector and the signal heard in the headphones will be much louder than the signal direct from the crystals. The fourth element of the valve is connected to the plate in this particular circuit and the two elements connected together behave in the same way as the plate in an ordinary triode.

You will note, too, that we have suggested a plate supply of only 9 volts. There are two very important reasons for doing this. If the maximum voltage permitted by the manufacturers were applied it would be necessary to apply a negative voltage to the control grid in order to keep the plate current down to a safe value and also it is not a good idea to pass too much current through the very fine wires which go to make up the coils in the headphones.

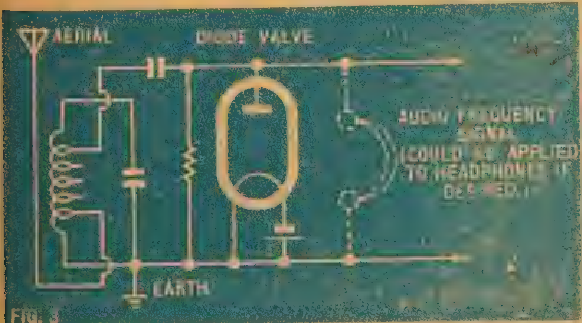

AERIAL
DIODE VALVE
AUDIO FREQUENCY SIGNAL (COULD BE APPLIED TO HEADPHONES IF DESIRED.)
EARTH

FIG. 3

☆

This form of diode detector circuit is included in the finished receiver. The grid and filament of the tetrode behave as the plate and filament of a diode so that there is no need for a separate valve.

☆

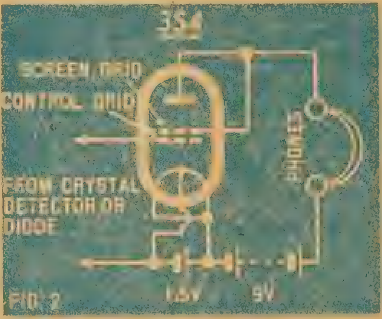


FIG 2

A practical version of the circuit of Fig. 1. A pair of phones replaces the meter and the plate voltage is reduced to 9 volts, for reasons discussed in the text.

The fourth element in the valve we mentioned a moment ago is called the "screen grid" or simply the "screen." It consists of a fine spiral of wire between the control grid and the plate. If the screen be connected separately direct to the battery supplying the plate the valve can be made to give a greater effective amplification and the signals appearing in the headphones will be louder than with the triode connection.

The screen grid was first introduced into valves to make them more satisfactory radio frequency amplifiers but that is another story.

We could build a valve amplifier using the 3S4 with a separate screen connection and attach it to a crystal set to get louder signals but there is an easier way to achieve the same result.

The control grid is close to the filament. If the other elements be ignored the control grid and the filament can be made to behave as a diode valve.

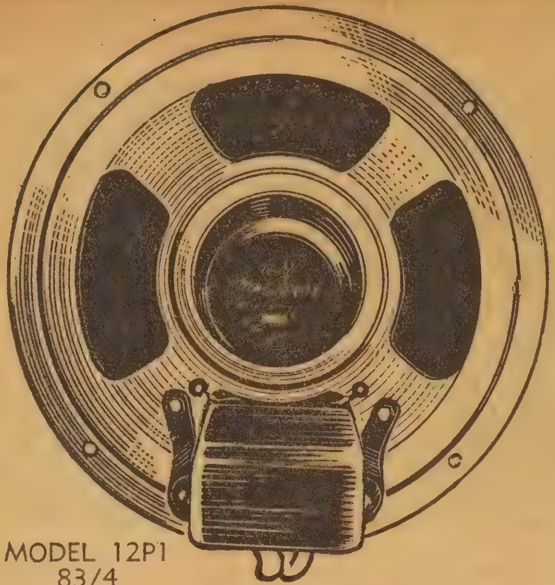
The same control grid controls the flow of electrons between the filament and plate so that it can take its part in behaving as an amplifier, while acting as a detector. This means that the valve can perform two functions and there is no need to have the separate crystal detector or diode valve.

There is one difficulty arising out of this. The diode detector is connected across the tuned circuit and while the tuned circuit has a high impedance as far as the radio frequency signals are concerned, it has a very low impedance in relation to the audio signals. If the detector were connected directly to the tuned circuit, the audio signals would be short-circuited to earth and the valve would not be able to amplify them.

REASON FOR CONDENSER

The difficulty can be overcome by connecting a condenser between the tuned circuit and the grid of the valve. The value of this condenser can be so chosen that it offers very little resistance to the passage of radio frequency signals but a very high resistance to the passage of audio frequency signals.

The condenser has the property of not allowing steady direct current to pass so that it is necessary to provide some means by which the few electrons collected by the grid can be allowed to flow back to earth. Otherwise, they would collect on the grid and build up a charge which would prevent the valve functioning correctly. This is done by connecting a resistor of a high value between the grid of the valve and earth.



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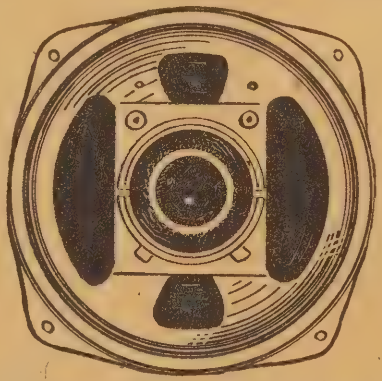
10P2-10"	**69/3**
10P1-10"	**74/11**
12P2-12"	**74/4**



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THE
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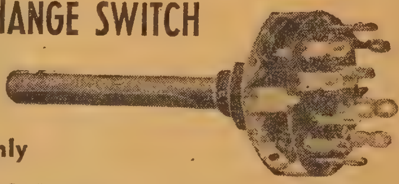

12/6

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2 Pole	6 Position	4 Pole	3 Position

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A resistor is simply a device which offers a resistance to the flow of electric current. In this case we need a high resistance because we do not want it to affect either the radio frequency or the audio frequency signals appearing at the grid but simply to allow the relatively small number of electrons to flow to earth.

Introduction of a resistor into the circuit adds one extra to your list of circuit symbols. The symbol for a resistor is simply a wriggly line. It seems to suggest the idea of offering resistance to the flow of current. Check with the schematic circuit, Fig 4.

Having told you something about how the valve can be made to operate as a detector and an amplifier, our next job is to explain how you can incorporate these improvements in the diode valve receiver.

EXTRA PARTS

The additional components you will require are few. A battery able to supply 9 volts is required for the plate supply.

If you have to buy the battery, about the best proposition is to wire a pair of 4½-volt torch batteries in series, as shown in the photograph. Connect the positive terminal of one to the negative terminal of the other. Then the remaining negative terminal will be connected to the earth of the receiver and the remaining positive will go to the headphones and the screen of the valve.

A check with the circuit and wiring diagrams will make these points clear.

There is no objection to connecting 6 torch cells in series to supply the 9 volts. Very little current is required and cells which are so low that they are no longer satisfactory in a torch will work quite well.

A fair amount of current is required from the 1.5-volt cell which lights the filament so that, if the set has had a lot of use since last month, it would be a good idea to renew it.

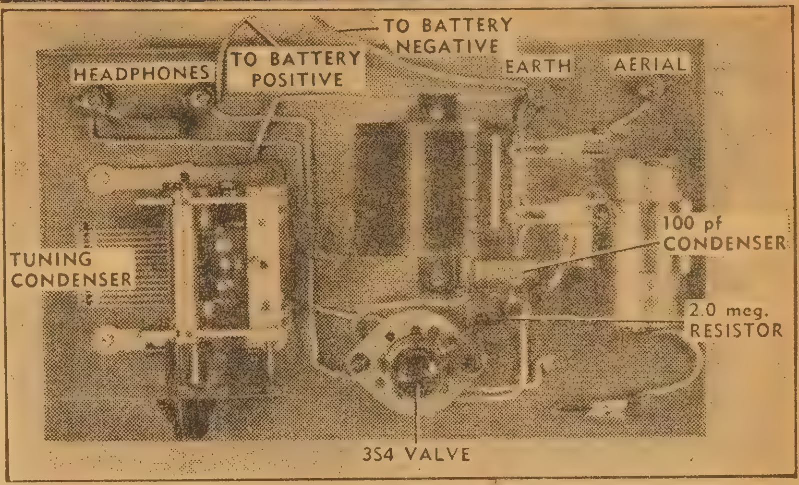
There have been a number of changes in the wiring since last month. You could pick out the wires that are the same and avoid disturbing them if you wish, but it may be a good idea to remove all the wires and start again. Not only will it allow you to proceed in a logical fashion, wire by wire, but you will have extra practice in reading the circuit and making solder connections.

Regard the schematic circuit as the standard diagram from which to work and use the diagram showing the position of each wire only if you get stuck. After you have finished all the sets in this series you should be able to wire from the schematic circuit without any assistance.

Actually you will find the schematic circuit easier than the wiring diagram after a while because it allows you to form a mental picture of how the set works.

In addition to the extra battery you will need an extra mica condenser and a small resistor for this month's set. In order to make a firm job of the wiring, these are mounted on a tag strip. The tag strip has four metal lugs riveted to a bakelite strip. One of the lugs has an extended foot so that it can be screwed to the baseboard or chassis as required.

TOP VIEW OF THE RECEIVER



From this picture you will obtain a good idea of how the wiring should appear in practice. The 9 volt battery does not mount on the baseboard. The leads to it may be made as long as necessary.

CONDENSER VALUE

The condenser is of a similar type to the one used in the two previous sets, although it has a different value of capacity. As before, it consists of a number of thin rectangular sheets of metal separated by thin sheets of mica. Alternate plates are connected to each other to form one terminal of the condenser and the other terminal is made by connecting together the other set of alternate plates.

This new condenser has a capacity of 100 pf or .0001 mfd. (There are 1-million picro farads to the micro farad.) That is, its capacity is about ¼ that of the maximum capacity of the tuning condenser. Mica used as the insulating medium and the fact that the plates are much closer together than in the case of the tuning condenser make it possible to have this value of capacity in such a small space.

The condenser shown in the photographs is by no means the only type that would do the job. Any mica condenser of the same capacity and in good condition may be used even though its physical shape is quite different.

The value of 100 pf was chosen because it offers an easy passage to the radio frequency currents, but does not allow the audio frequency currents to pass to any worthwhile extent.

In order to allow any electrons which may collect on the grid to leak away to earth, a high value resistor is connected between grid and earth. The value in this case is 2-million ohms, or 2 meg, to use the usual abbreviation. Compare this with 14 ohms for the filament of the 3S4 valve. High-value resistors are frequently used in radio circuits and you will meet more of them later on.

RESISTANCE AND IMPEDANCE

Possibly you are a little puzzled by the difference between the resistance offered by a condenser and the resistance offered by a resistor. It is something that is hard to understand at first but the main thing to remember is that while a resisor offers the same resistance to the steady direct current from a battery as to audio frequency currents and radio frequency currents, a condenser offers an infinitely high resistance to direct currents and a progressively lower resistance to audio and radio frequency currents as the frequency is increased.

As a matter of fact, the resistance offered by a condenser is of a very

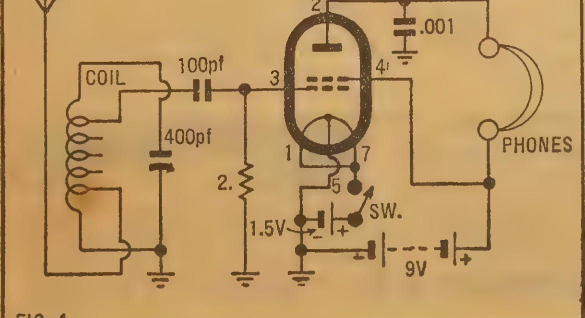


FIG. 4

☆

The symbol for a resistor appears for the first time in the schematic circuit of the complete receiver. The filament of the 3S4 is wired so that it operates from 1.5 volts but with a different arrangement it can be operated from 3.0 volts.

☆

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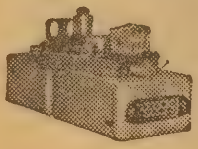
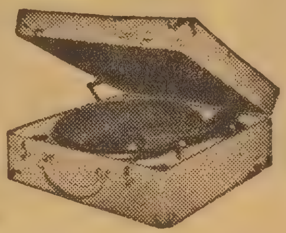


Car Radio Kit, as described in "Radio and Hobbies," March, 1952, issue. Karset complete to the last nut and bolt, including 6in. Rola Speaker and Box. Price including sales tax, 22 Gns.



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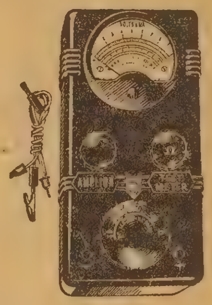

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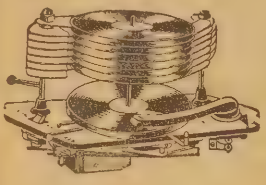
1,800 ohms per volt. Three voltage ranges AC/DC, two milliamp. ranges and resistance up to 200,000 ohms. Self-contained battery. Complete with test prods., price only £8/15/-, plus 12½% sales tax.



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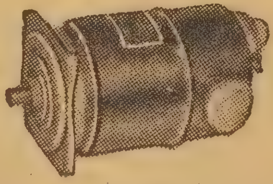

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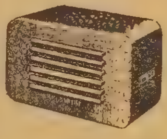

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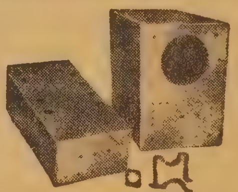

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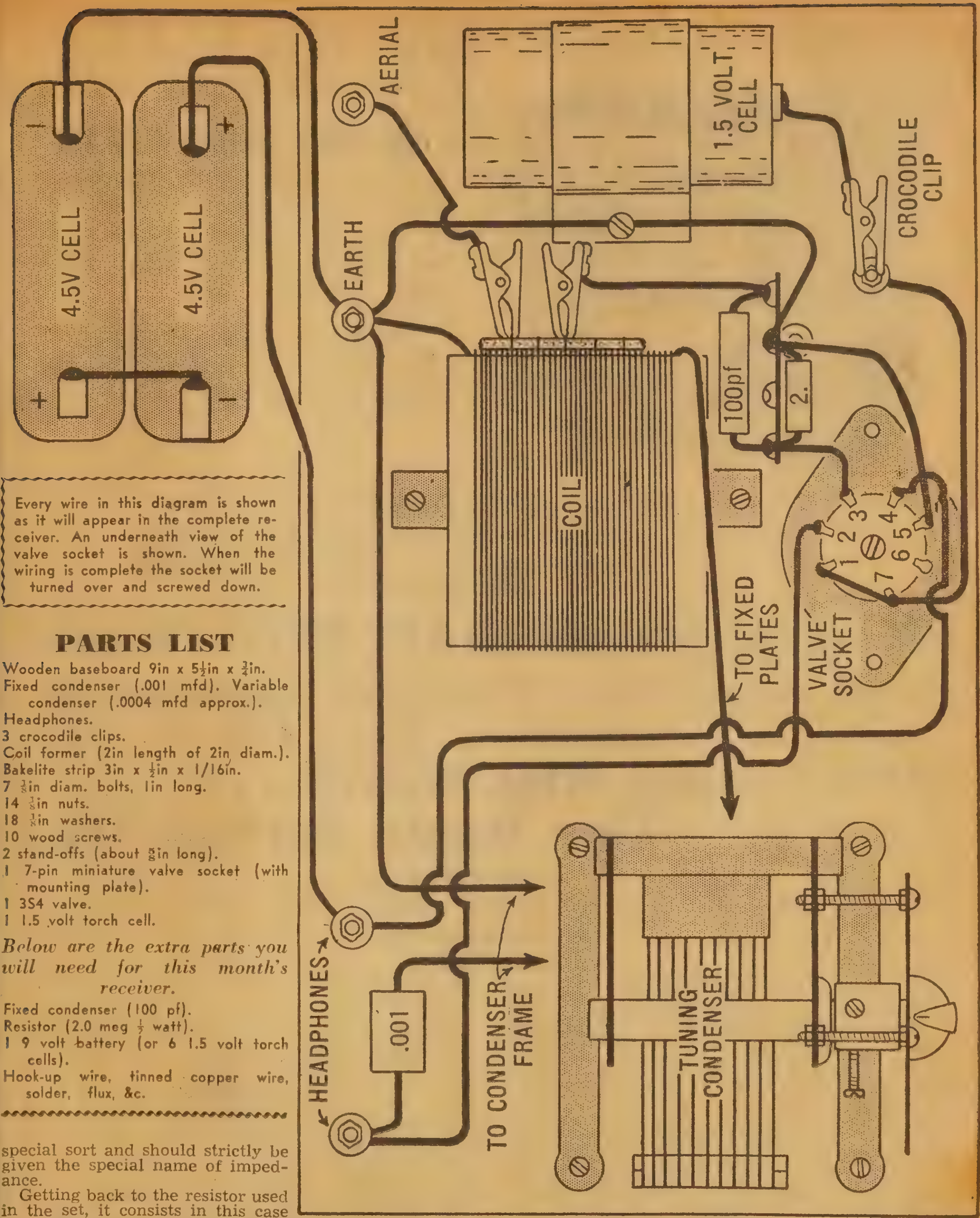

Every wire in this diagram is shown as it will appear in the complete receiver. An underneath view of the valve socket is shown. When the wiring is complete the socket will be turned over and screwed down.

PARTS LIST

- Wooden baseboard 9in x 5½in x ¾in.
- Fixed condenser (.001 mfd). Variable condenser (.0004 mfd approx.).
- Headphones.
- 3 crocodile clips.
- Coil former (2in length of 2in diam.).
- Bakelite strip 3in x ½in x 1/16in.
- 7 ⅛in diam. bolts, 1in long.
- 14 ⅛in nuts.
- 18 ⅛in washers.
- 10 wood screws.
- 2 stand-offs (about ⅝in long).
- 1 7-pin miniature valve socket (with mounting plate).
- 1 3S4 valve.
- 1 1.5 volt torch cell.

Below are the extra parts you will need for this month's receiver.

- Fixed condenser (100 pf).
- Resistor (2.0 meg ½ watt).
- 1 9 volt battery (or 6 1.5 volt torch cells).
- Hook-up wire, tinned copper wire, solder, flux, &c.

special sort and should strictly be given the special name of impedance.

Getting back to the resistor used in the set, it consists in this case of a thin layer of carbon which is sprayed over a tiny piece of glass tubing. The carbon is sprayed on in such a way that it makes contact with two leads each of which is pushed a short way into the ends of the glass tubing. In other words the electric current has to flow through the thin layer of carbon before it can get from one wire to the other.

When the glass tube with its resistance element and the two copper connecting leads are moulded into bakelite to form a tube, the leads are quite firm and can be used to hold the resistor in place as well as make the electrical connection.

Resistors can be obtained not only in different values but designed to carry different values of current. You need not worry too much about this at the moment because even the smallest resistors obtainable will be plenty big enough for the sets in this series.

By the way be sure not to get the idea that the physical size of a resistor is a guide to the value of the resistance. Nothing could be further from the truth.

Small resistors and condencers can be mounted by soldering their connecting leads to the metal lugs of a tag strip or some other support capable of firmly suporting their weight. Sometimes you can make use of valve sockets for support but since miniature valve sockets are relatively small and fragile, it is not a good idea to try to solder too many components to the one lug. Don't be tempted to make joins between small components and wires without a tag strip or some other support. The danger is that the

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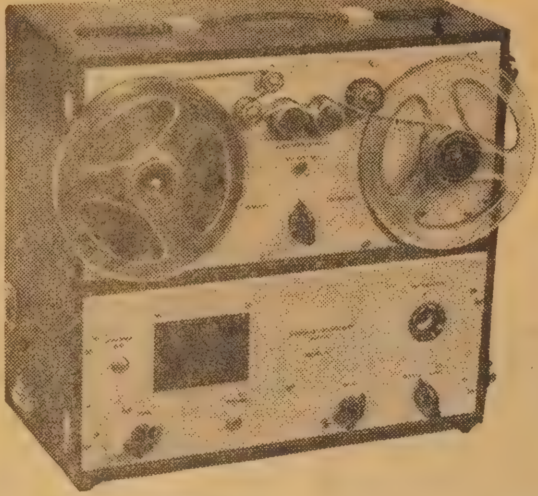

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parts will shift and cause a short-circuit.

Often the leads attached to small components are up to 2 inches long and if the full length were used a very messy job would result. Cut the leads to the length required before making the solder joint. If you are doing experimental work, and it is possible that the components will be used again, it is not a good idea to cut the leads too short.

In wiring the receiver we suggest that you start by connecting the leads to the valve socket. As the screen and control grid are used separately, there will be more connections to the valve socket than last month.

THE WIRING

Connect pins 1 and 7 together and attach a length of hook-up wire to either one. In this case the hook-up wire can be about 6 inches long. The excess can be cut off later.

The plate connection of the 3S4 valve can be made to either pin 2 or pin 6 as both are connected together inside the valve. Attach a piece of hook-up wire about 9 inches long. All the other connections will be obvious from a study of the schematic circuit and the wiring diagram.

With the wires connected to the valve socket it may be screwed in place and you can proceed with making the various other connections. In some cases connections are made by securing the bare wires under the tin washers, while others are soldered.

The two wires going to the negative terminal of the filament cell are connected simply by virtue of their being pressed under the metal clip holding the battery. A similar procedure is adopted with the two connections which are made to the frame of the tuning condenser.

Two wires, one from the earth terminal and one from one of the headphone terminals are required to make connection with the 9-volt battery. You may leave these a foot or so in length so that the battery be placed in the most convenient position.

A little more care is necessary when testing this set than was necessary last month, because if you have made an incorrect connection which allows the 9-volt battery to appear across the filament of the valve, the latter could easily be damaged quite beyond repair.

SWITCHING ON

The best procedure is to connect up everything except the 9-volt battery first. Then complete the filament circuit by attaching the crocodile clip to the terminal post. Make sure then that the filament reaches the correct temperature which in the case of the 3S4 is a dull red.

You may not be able to see inside the plate by looking from the top, but if you look from underneath you should be able to see the thin red line of the filament. If you cannot do this, on no account connect the 9-volt battery because you run the very real risk of burning out the filament.

After you have made sure that the filament circuit is in order connect the 9-volt battery, the negative terminal to earth and the positive terminal to the headphone terminal. Make sure that it is the headphone terminal which goes to the screen of the valve rather than the one which goes to the plate.

With the aerial and earth connected and the crocodile clips from the aerial terminal and the 100 pf condenser connected to the coil, you will be able to hear some signals. You can experiment with the coil tappings for best results, but you will probably find that the set works best with the aerial tapping connected near the earthed end of the coil, as in the case of the crystal set. However, you will find it possible to connect the other tapping further up the coil than was possible with either the crystal set or the diode valve receiver without reducing the selectivity to the point where adjacent stations overlap. With the tap connected up near the top of the coil, signals will be loudest and selectivity will be least. You can decrease the volume if you find local stations too loud by connecting the tap closer to the earthed end of the coil. If necessary it can be connected to the same tap as the aerial.

RESULTS

Because of the amplifying ability of the valve signals will be a good deal louder with this receiver than with either of the other receivers. Also, because the new detector circuit has a lower loading on the tuned circuit than in the previous case the selectivity will be better. All in all you will find that the set is a really worthwhile improvement over the two earlier jobs.

We could easily have told you how to build this set, or even a more advanced one right from the beginning, but if we had done that you would not have gained an understanding of how it operates, nor would you have been in a position to realise the improvement made by the amplifying valve.

Next month we intend to take you a step further. To the simple detector and amplifier circuit we will add what is known as a regenerative circuit. This circuit allows a very big improvement in both volume and selectivity. A regenerative receiver is more critical in its adjustment than a straight detector and amplifier and some of the constructional techniques that are quite okay in a very simple set will no longer do.

The wooden baseboard will be replaced by a metal chassis. We have planned this chassis so that it will accommodate the finished two-valve receiver. Of course, you will not need all the chassis holes right from the start, but the chassis complete with all the holes will allow you to proceed from one design to the next without the need for extensive mechanical work.

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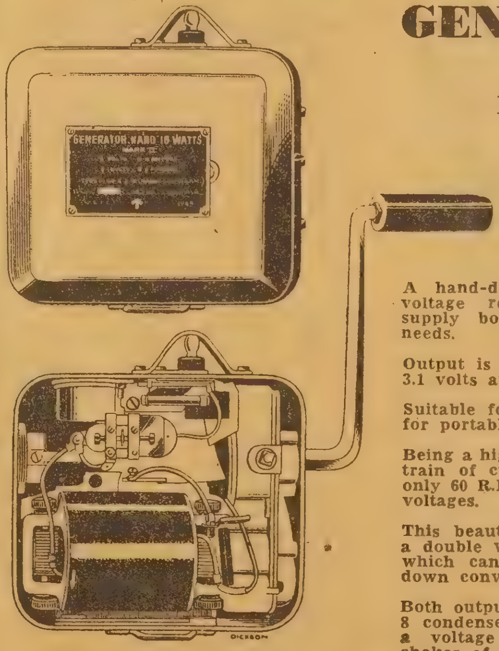

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A hand-driven Generator delivering voltage regulated D.C. current to supply both high and low tension needs.

Output is 162 volts at 0.06 amps. and 3.1 volts at 0.3 amps.

Suitable for small Radio Transmitters for portable or emergency use.

Being a high geared unit with a 64 to 1 train of cut bronze gears it requires only 60 R.P.M. to obtain the necessary voltages.

This beautifully built unit comprises a double voltage ball-bearing dynamo which can be used as a step-up or down converter, or motor.

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Here's your answer, Tom!

Although we do make an effort to appear reasonably modest, some of our younger readers seem to get the idea that we are a lot cleverer than we actually are. For example we haven't yet designed a tuner to satisfy the requirements of our first enquirer this month. If we ever do succeed in designing a piece of equipment that is absolutely perfect, rest assured that we will be the first to tell you about it.

WE probably never will. As a matter of fact, radio would not be half so interesting if everybody knew how to make a perfect tuner, a perfect amplifier, a perfect pickup and a perfect loudspeaker. We will always struggle toward that goal, ever getting closer and closer, but never quite reaching it. Makes you think, doesn't it?.

In the meantime, we will get back to the question which brought on that piece of philosophy.

Could you supply me with the circuit of a tuner including an RF stage, good selectivity and having perfect fidelity? A noise limiter would also be desirable.

We wish we could, Tom, but unfortunately your requirements are a long way ahead of anything in our files, or anything that we are likely to have for a long time to come.

The reason is that good fidelity cannot be obtained when the selectivity is also good and further that it is very difficult to design a noise limiter which does not have an effect on the quality.

You see, Tom, when a radio transmitter broadcasts a modulated signal, not only is the carrier wave present but also a series of sidebands. These sidebands depend on the frequency of the modulation. The higher the modulation frequency, the greater distance on either side of the carrier frequency they appear.

In order for a radio set to reproduce the higher modulation frequencies, it is necessary that the bandwidth be sufficiently great to allow the sidebands to pass, together with the carrier.

If you make the bandwidth great, then the chances of noise and interference from adjacent stations getting through becomes greater. This simply means that you can't get noise-free, high-quality reception from a radio station unless the signal is sufficiently strong for the noise to be negligible. Our remarks apply particularly to AM, but a similar situation applies in the case of FM signals.

If you are keen to get the very best in quality, we would recommend something along the lines of the high fidelity tuners described in the August and September issues of this year. On the other hand, a set along the lines of the "1952 Advance" may be an excellent compromise. It has fairly good selectivity under ordinary conditions, but a switching system in the IF channel allows the selectivity to be reduced for better quality reception of the local stations.

You can't have your cake, Tom, and eat it, too.

Will you please explain why reversed connections on a coil affect the performance? If the coils are wound in the same direction and we are dealing with AC currents, I can't see why this should be.

In addition to the normal inductive coupling between the two windings in the coil, there is a capacitive component due to their proximity. The manufacturer normally marks his product so that the capacitive component assists the inductive coupling.

If the connections are reversed, the components oppose rather than add, with the result that the gain drops considerably.

In cases where the capacitance due to the proximity of the coils is insufficient to provide the desired characteristic a special capacitor is included. In this case, the result of reversing the connections would be even more disastrous, the extra capacitance acting as a bypass rather than a coupling medium.

What is meant by aerial peaking?

We are not quite sure in what context the phrase appeared, Tom, but you should have no difficulty in applying our explanation to the case you have in mind.

A tuned circuit (or an aerial) has a natural resonant frequency which is dependent on the value of the inductance and capacitance or the physical constants of the aerial as the case may be. At the resonant frequency, the impedance of the tuned circuit is greater than at higher or lower frequencies.

Now, Tom, if we take a piece of graph paper (paper divided up into a lot of little squares) we can draw an interesting curve to illustrate the behavior of the tuned circuit.

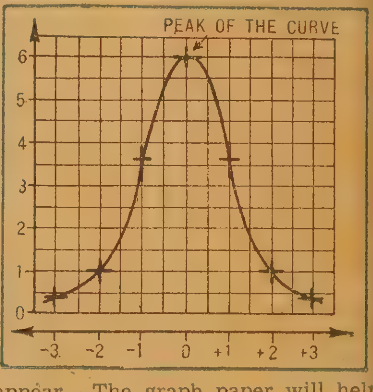
We will take it for granted that we have an instrument which is able to measure the impedance of the circuit at different frequencies.

We can use this instrument to find the frequency at which the impedance is highest and we will call this frequency reference zero. Then frequencies higher will have a plus number and frequencies lower will have a minus number.

TO ILLUSTRATE

In the case we are about to illustrate, the greatest impedance of the tuned circuit is 6 units, and a quick check with our impedance measuring instrument is enough to show that it falls to almost zero if the frequency is changed about 3 units either side. This is enough information for us to begin drawing a graphical illustration of the behavior of the tuned circuit.

We take a piece of graph paper and rule a horizontal line near the bottom. Near the centre of the page we mark O on one of the vertical lines and plus 3 on one of the vertical lines over to the right of the page. An equal distance to the left of the centre mark minus 3. Now, if you divide the space evenly, you can mark in where the 1 and 2 frequency units either side of the zero mark will appear. The graph paper will help you to do this.



Taking any convenient distance as equal to one unit, mark a point 6 units vertically above the zero frequency point. Then measure the impedance at a frequency of plus 1 unit and mark a point vertically above the plus 1 frequency point a distance representing the impedance of the circuit at this frequency.

Do the same for frequencies of plus 2, plus 3, minus 1, minus 2 and minus 3. You will then have a series of points which seem to fit together. There is no need to confine yourself to making measurements at even frequencies. See what appens when you plot the values at , 1½ &c frequency units.

If you take enough points you will ind that they almost fit together o form a smooth curve. In fact, ou can easily predict where the ntermediate points will come simply y drawing a smooth curve through he points with a pencil. The finshed result will be something like he curve we have shown here.

The great advantage of presenting he information about the tuned circuit in this way instead of as a series f figures is that you can tell quite lot about it at a glance and further t is very easy to compare the perormance of one tuned circuit with nother.

When people say something or ther has reached its peak, although hey may not be very clearly aware f it themselves, they are actually eferring to the peak in a graph such s this. For example, you could raw a graph to illustrate tomato roduction in Southern Queensland. uch a graph may indicate that tonato production in Southern Queensand reached a "peak" in 1947.

Would a 100 mA meter detect a eak in a condenser?

Well, Tom, that depends mainly n the leak, but possibly you aren't oo clear as to how a meter is used o test condensers so a few words n the subject may help you.

A condenser isn't a source of elecrical energy so that if you connect meter across the condenser there vill, of course, be no indication. If ne condenser happens to have a harge before connection, there will e a sudden movement of the needle, fter which it will return to the zero osition and stay there. Don't pracice this, by the way, as you could asily damage the meter.

At any rate, because the condener does not supply energy for the est it will be necessary to obtain from elsewhere. The most conenient source is an ordinary dry ell or cells.

The 0-100 mA meter has a very ow internal resistance so that it vill allow a very heavy current to ass if connected across the dry cell. his will damage both the cell and he meter. However, if a resistance, vhich in this case works out to 15 hms, be connected in series with ne cell and the meter and the circuit completed, a current of exactly 00 mA will flow. In other words, ne meter will read exactly full scale vhen the total resistance in the circuit is exactly 15 ohms.

METER READING

If then you happened to have a ondenser with a short circuit and onnected it in series with the meter nd battery, the meter would still ead 100 mA. If the condenser were good one with a very high resistnce on the other hand, the meter ould not read at all, although possly with a high value condenser here would be a slight reading as ne circuit is completed and while ne condenser is charging. So, Tom, ou could use a 100 mA meter for this ery simple test on condensers and so for checking the continuity of her electrical circuits.

You will now ask about what will appen if the condenser or circuit nder test is neither a direct short rcuit nor an open circuit, but has me resistance. To take a particular example, if it has a resistance of 15 ohms then the total resistance in the circuit will be 30 ohms and you can work out from Ohm's Law that a current of 50 mA will flow. The meter will therefore read ½ scale.

Perhaps you have been scratching your head over some problem concerned with elementary radio or electricity. If you would like to put yourself in Tom's shoes, address a letter to the Technical Editor, Radio and Hobbies, Box 2728C GPO, Sydney, NSW, marking it "Answer Tom." If your question is likely to be of interest to other readers, we will answer it in an early issue. Include your name and address, not for publication but simply as a mark of good faith.

Knowing the voltage of the battery, and the current flowing in the circuit, you can always work out the resistance in the circuit. Simply divide the voltage of the battery by the current indicated by the meter (expressed in amperes) and this will give you the total resistance in the circuit. The value of the current limiting resistor in the circuit should be subtracted to give the correct value of the unknown resistance.

Just to make the matter clear, we will work out an example. Say you are using a 100 mA meter and a 1.5 volt battery with a 15 ohm resistor included so that the meter and battery will not be damaged. You connect the unknown resistance into circuit, noting that the meter reads 1/10th full scale or 10 mA.

The total resistance in the circuit is 1.5 divided by 0.01, which equals 150 ohms. The resistance of the meter is so low that it can be neglected, but the limiting resistor must be subtracted from the total value to give the value of the unknown resistance, which is in this case 135 ohms.

SENSITIVE METER?

While the 100 mA meter may be used in this way there are many applications where a more sensitive instrument is desirable.

It just occurs to us that you may have had in mind the idea of connecting the meter in series with the condenser in the set while it is operating, with the idea of measuring the leakage current. The objection to this is that there is nothing to limit the current flowing and if a condenser connected across a high voltage happened to be faulty the meter may be damaged.

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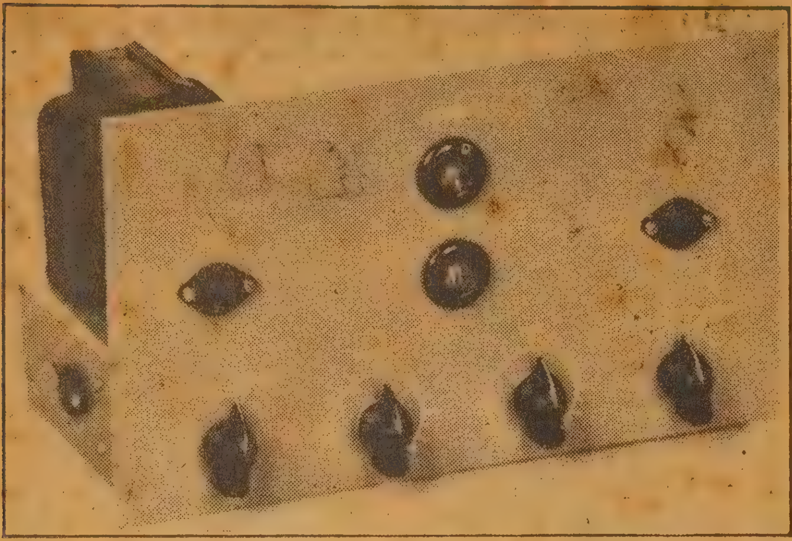


A front view of the amplifier unit. An engraved panel (a job which can be done by advertisers) gives a neat finish. The plug for head connection is seen at the right hand side beneath the output transformer. "Output" on the panel refers to the speaker.

THE R&H TAPE RECORDER No. 1

Here is a simple, high quality tape recorder which has been thoroughly tested to give results almost flat from 50-8000 cycles, using a tape deck driven from an ordinary 78 turntable. It should be the answer to a need expressed by large numbers of our readers.

by John Moyle

THE interest in tape recording is undeniable. There is something about the plastic reel and the apparent simplicity of recording, wiping out, and recording again, which fascinates everybody. We've lost count of the number of people who to our knowledge have set out to build recorders. Not many of them stayed the course.

For there is more in this tape business than meets the eye. The most interesting discussions now being conducted in the "Argument" series at the moment are only one indication of this. To design a successful recorder, one must have a good understanding, not only of audio amplifiers, compensation methods and so on, but also of the magnetic principles on which the tape has been designed, the importance of the bias oscillator, and the effect of the recording and playback heads on all these things.

MECHANICAL HURDLES

Even when you have steered your way through the electrical side, there is still the mechanical hurdle to overcome, and this is probably the hardest of all. It bristles with problems of "wow" and "flutter," due to varying tape speeds, proper control of the reel speeds, provision of fast rewind, brakes and clutches.

"Well, I'm blowed," says our optimist who started out to build a recorder, "and I thought it would be so simple!"

But wait a moment—things aren't really as gloomy as they might seem! As anyone who has started out to build a recorder will tell you, most of his troubles grew from not having a clear picture in his mind of what he wanted before he began. Or perhaps in having wanted too much, only to stumble because he found the job beyond him.

If it is necessary for the individual builder to clarify his ideas before making a start, how much more important is it for us to do so if we are to offer some guide to you on the road to success?

SEVERAL STAGES

To date we have been content to publish articles surveying the design position, because we didn't feel we had reached finality in our own constructional ideas. We believe there are several stages between the simplest device, which will record and playback acceptable tapes with the minimum of equipment, and a first-rate machine, which provides all the facilities of fast forward and re-wind speeds, multiple heads and so on.

Just what these stages are still needs a little working out. But the first step now seems quite clear. It is to provide a simple machine for recording and playback which will drive from any good quality gramophone motor having plenty of "tow," plus a record-playback amplifier with the minimum of valves to use with it.

GRAMO-MOTOR DRIVE

This idea of a gramo-motor driven deck has appealed to us for some time. Various types have been produced overseas, and the first Australian-made job has now been released on the local market. Neville Williams has been working on one for some months and his progress, plus the success of the commercial job mentioned above, leads us to believe that here is the mechanical answer for a very large proportion of home tape recorders. We'd not be at all surprised if, before long, other decks of this type become available.

The first and completely essential thing for success is that the motor should be of good quality, and should run absolutely smoothly. Any variation in speed will inevitably cause "wow," which will spoil results. A very small speed fluctuation may not show up except on sustained musical notes and instruments, such as the piano, and will not be noticeable on voice. Such a motor would be quite OK for playing about.

SMOOTH RUNNING

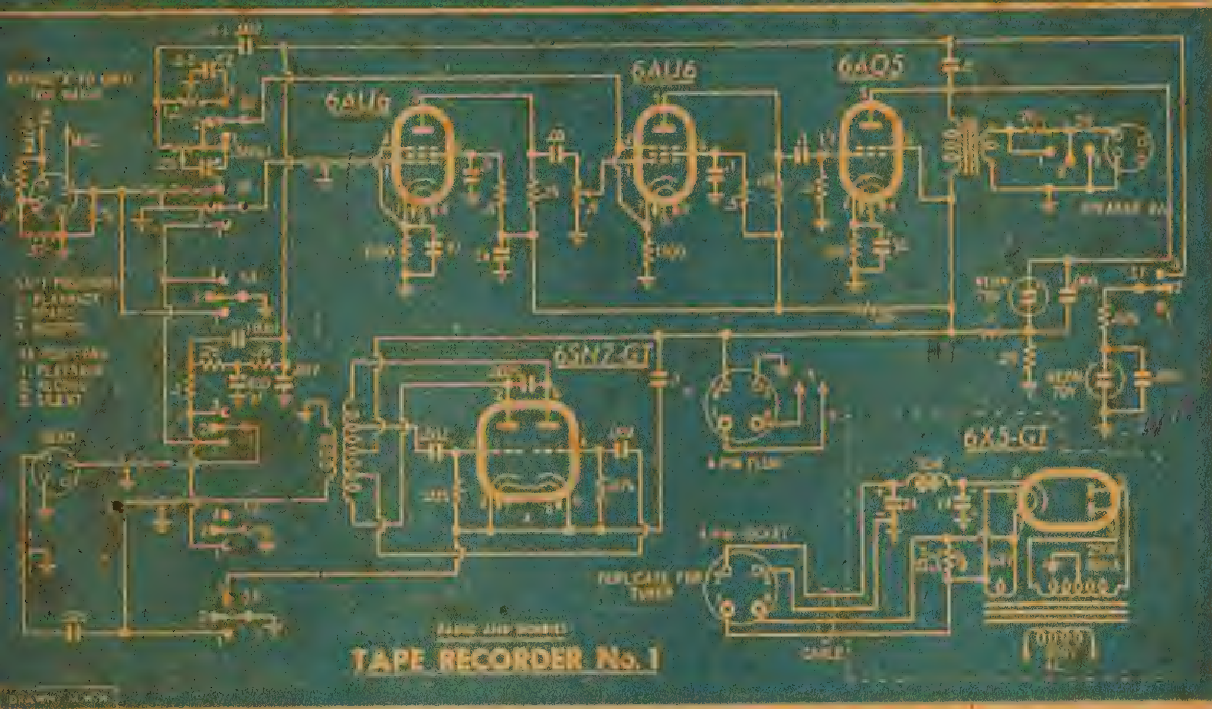
But as soon as really good tapes are wanted, a motor in first class condition must be used. The best motors seem to be the standard governor types of which the Collaro, Garrard, &c., are examples. The light-duty three-speed motors, widely used today, are generally not powerful enough to pull the deck without slippage and/or speed reduction.

We might point out that a smooth-running motor isn't a requirement of tape alone—it is just as important for discs. What we mean is that "any old motor" won't do. For best results it must be good.

There is little doubt that many perfectly good 78 type motors will be discarded as micro-groove records grow in popularity, and their use with tape decks looks a most attractive proposition. Even if the motors are a little worn, it should be possible to have many of them reconditioned so that they will run smoothly.

We intend to make some experiments with such motors by increasing the mass of the turntables as a further precaution against rough run-

CIRCUIT DIAGRAM OF R.&H. TAPE RECORDER No. 1



All "record-playback" switching, except S7, is shown at the left for clarity. Note that the power supply is mounted on a separate chassis. A second power output socket may be provided for a tuner if the supply uses an 80 mill transformer. Use a good speaker transformer for best results. For extra bass use .015 mfd for C1. For less highs use .015 mfd for C2.

ning. The turntable makes an excellent flywheel, which can be used to good advantage.

As already mentioned, the deck sits over the turntable, and a flexible rubber foot drives a spindle, to which the capstan which pulls the tape is attached. On the deck are mountings for the two reels—the supply reel and the take-up reel. The latter is driven by a belt, which spins its spindle at a speed higher than that of the capstan.

The reel is coupled to the spindle by a felt washer as a slipping clutch, so that there is always some tension on the tape as it comes off the capstan. This takes some of the capstan load, and ensures an even wind on the tape. An extra weight on this reel sometimes helps in the process.

SINGLE HEAD

The supply reel runs on a fixed pindle and also has a felt washer o maintain tape tension by its drag. The tape is guided over the single ecord-playback head by one or more osts or pulleys. In the commercial ersion mentioned (Byer Type TM-) the capstan is of neoprene, which xhibits a natural adhesion for the lastic tape, and is provided with a leaning and oiling pad to assist in he process.

To rewind the tape, the reels are hanged over to opposite spindles, nd the plastic belt slipped up to a arger diameter pulley on the drive pindle to step up the speed. If the notor has a governor, this is pushed nto its "fast" position, allowing a -inch reel to be rewound in about ix minutes.

A bulk eraser is provided with the leck, which allows the tape to be rased in a few seconds either as a ull reel or a partly full reel.

This type of deck is obviously not suitable for work which involves much editing of tape, erasing of small sections and substituting new recordings, &c. But it is ideal for anyone who wants to record items varying from, say, 10 minutes to 30 minutes, to play them back until he tires of them, and to wipe them off for further recordings. We are convinced that there are large numbers of readers who want to do just that. Obviously, there need be no compromise in the quality as far as the head is concerned.

So much for the mechanical side of the recorder. Its simplicity leads us to believe that many readers will be interested in making a similar deck, and in a later issue we hope to give some guidance for them. But there is an equally well-defined group to whom the mechanical construction will not appeal, and they will, of course, use commercial versions.

Both groups will have to face the problem of a suitable record-playback amplifier, and the purpose of this article is to provide them with the necessary details. The amplifier is, of course, suitable for use with any mechanism using a high impedance head, and represents a good example of how to go about the job.

It is essentially similar to that advised by the makers of the tape deck. There are of course, other

PARTS LIST

1 Panel 10½" x 6"
1 chassis 9½" x 5½" x 2"
1 output transformer for optimum load of 5000 ohms
1 3-pole, 3-position, 3-gang switch, 1 3-pole, 3-position switch
2 70 volt indicator neons
3 miniature 4-pin sockets with plugs, 1 standard 4-pin plug, 3 7-pin miniature valve sockets (2 with shields), 1 octal socket.
1 special bias oscillator coil for push-pull 6SN7GT

VALVES

2 6AU6, 1 6AQ5, 1 6SN7GT

RESISTORS

1 .5 meg. ½w, 1 1.5 meg., 1 .1 meg. ½w, 3 .5 meg., 1 .5 meg. and 1 .25 meg. potentiometer, 5 .25 meg., 2 .1 meg. ½w, 1 .05 meg., 1 .03 meg. ½w, 3 .025 meg., 2 1500 ohm, 1 250 ohm WW, 1 20 ohm

CONDENSERS

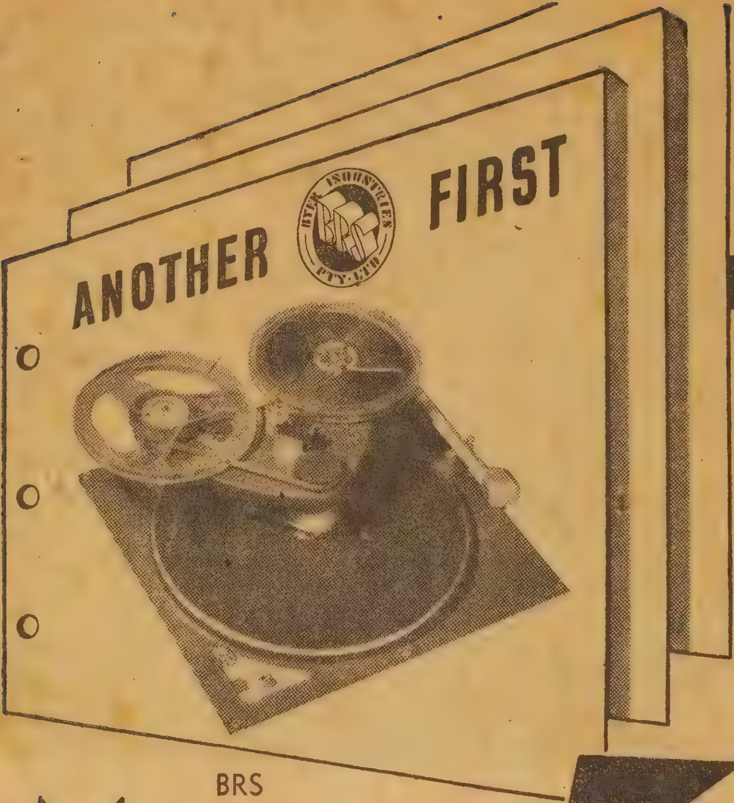
2 50 mfd 40PV electrolytics, 1 24 mfd 350PV electro., 2 .5 mfd 350WV, 3 .1 mfd 350WV, 1 .05 mfd 350WV, 1 .03 mfd, 3 .005 mfd, 4 .002 mfd, 1 500 pf, 1 400 pf, 1 100pf.

SUNDRIES

4 pointer knobs, 2 8-tag, 2 5-tag, 1 4-tag and 1 3-tag mounting strips, scrap aluminium for shields, hook-up wire, spaghetti, shielded wire, solder lugs, solder, nuts, bolts, &c

POWER SUPPLY

1 chassis, 8½" x 4" x 1¼"
1 power transformer 250 a side at 80 mills, 6.3V 2A, 5V 2A. (may be special shielded type)
1 20 or 30H filter choke 80mA
2 24 mfd 350 electrolytics
1 6X5GT, 1 octal socket, 1 50 ohm CT WW resistor, 3-core power flex and 3-pin plug



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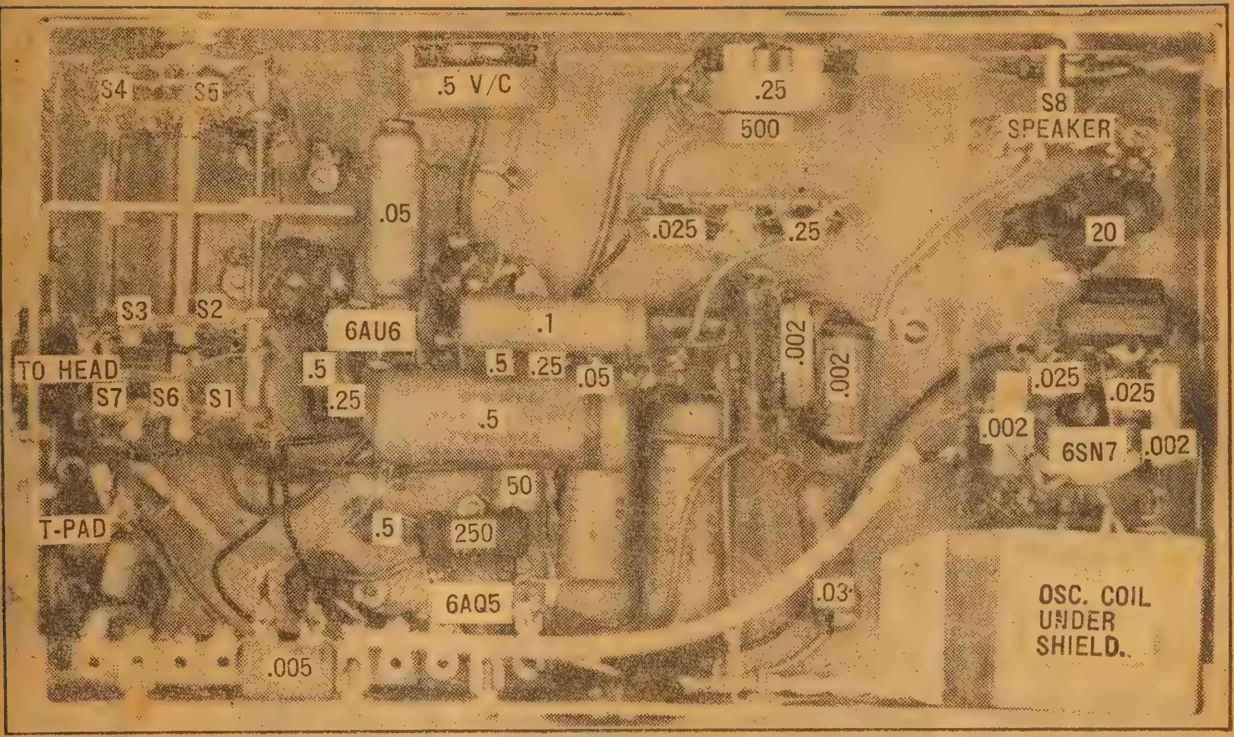
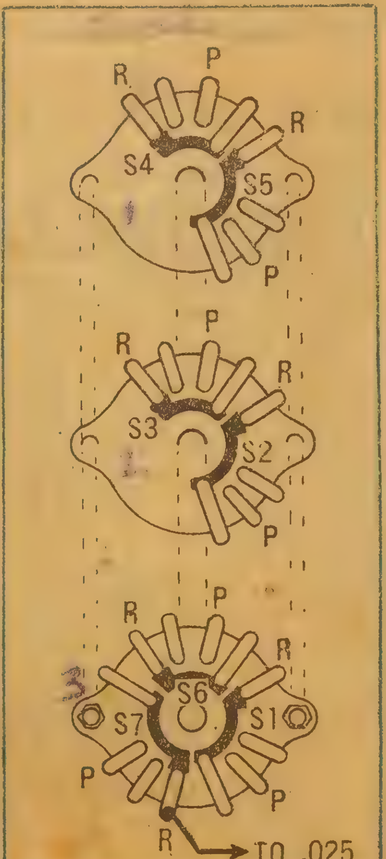
UNDERCHASSIS LAYOUT OF THE TAPE RECORDER No. 1



Most components can be located from this photograph. A small shield plate should cover S4 and S5 if a complete chassis shield plate is not used. The oscillator coil is hidden under the shield at bottom left. Below—Diagram showing the order of switch sections. Keep all wires direct and short as possibe.



ways of building tape amplifiers but the performance of this one would be difficult to better. Moreover, the approach is a logical one, and exhaustive tests have not revealed any cranky tendencies or hidden pitfalls. The original model worked right away and required only a few constructional modifications.

It is possible that slight variations are to be expected with different heads and makes of tape, but using the values shown in the circuit, the response into a resistive 2 ohm load using "Scotch Boy" tape varied less than 1½ db. from 50-7000 cycles, was 3 db. down at 8 Kc. and 7 db. down at 9 Kc. These figures are much better than most recorders selling for up to £150.

INPUT

Considering first of all the recording process, the amplifier should contain inputs for radio programs, microphone, and pick-up, amplify these appropriately, and provide a feed-point for the head as a recorder. Facilities for monitoring the material being recorded are needed, with a switch to quieten the monitor to avoid feedback to a microphone. Some indication of overload level must be included, also a bias oscillator to reduce tape noise.

On playback, the amplifier must accept the output of the head, amplify it, and feed it through to the loudspeaker.

This isn't a hard job so far. But somewhere along the line we must provide compensation for the tape, which involves a large amount of bass and treble boost to flatten out the characteristic droop from about 2-3 kc. Fortunately, the droop is smooth in character, and free from peaks which often complicate a similar approach with pick-ups.

The degree of compensation at both ends of the scale is so large that it has been split up between the functions of the amplifier as a recorder and a playback unit.

As a recorder, the first 6AU6 is used as a straight pre-amplifier to lift initially the output from the head. The second 6AU6 and the 6AQ5 form the second amplifier section, which incorporates a negative feedback circuit by coupling some of the output into the cathode resistor of the 6AU6. This feedback reduces the gain of the amplifier and also its distortion.

BASS BOOST

The feedback circuit is used to obtain the first step in compensation. You will note a condenser of .002 mfds in series with the feedback line to the switch section at the top of the circuit. This provides bass boost by restoring some of the amplifier gain at the lower frequencies. You will also note that a condenser is switched across the 6AU6 bias resistor during recording. This removes some of the feedback at high frequencies and gives a considerable degree of high frequency boost.

Removing feedback at these frequencies also allows the effective voltage output impedance of the 6AQ5 to rise as the frequency increases, this impedance having been greatly lowered in the first place by the application of feedback.

The recording head, which, of course, consists of a coil of wire wound around the core, also has an impedance characteristic which rises with frequency, so that there is at

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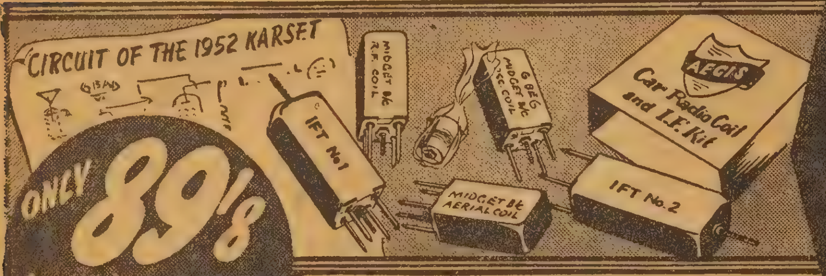
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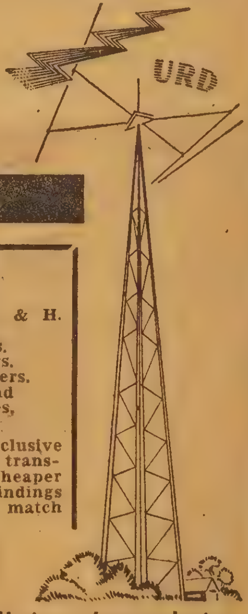

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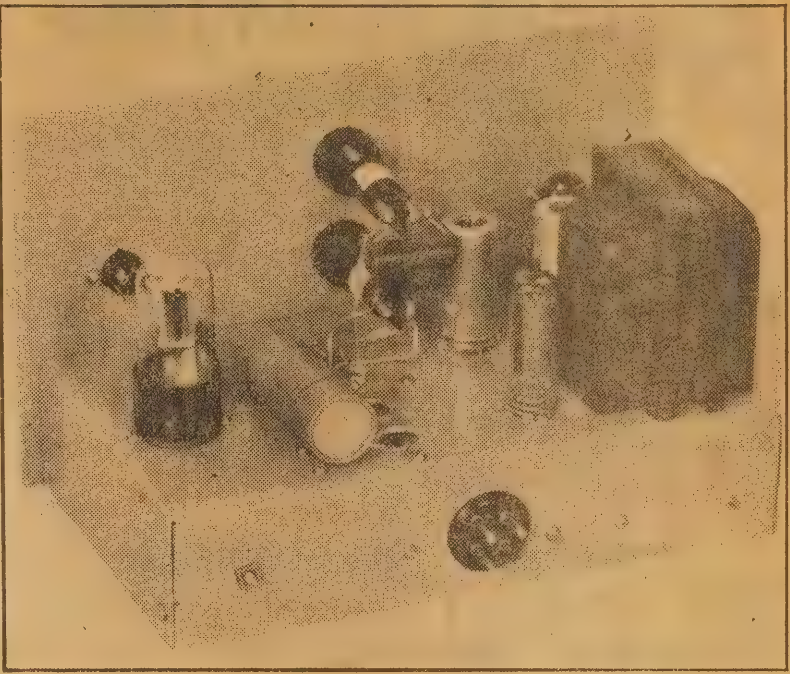


This rear picture shows the 24mfd decoupling condenser and other components. The input socket is partly hidden by the speaker transformer. The plug at the rear takes a power socket from the supply. The oscillator coil could be mounted above the chassis in front of the 6SN7 at the left. A 12AU7 could be used here.

least, a partial impedance match obtained to assist in boosting the highs. This principle, it will be remembered, was first used with great success in the case of the disc recorders which have been described during the last 18 months.

The head itself is fed from the 6AQ5 through a high resistance network. The use of this resistance assists in keeping the current through the head at a more or less constant value in accordance with principles described in previous tape articles, and which is quite important. There is plenty of output from the 6AQ5 to overcome the loss which this method imposes.

THE T-PAD

Portion of this high resistance network is taken up with a compensation pad (known as a bridged-T network) the function of which is to give a second degree of bass and treble boost. The exact amount is determined by the choice of resistor and capacitor values, which have been selected to suit the head of the Byer unit. They should be reasonably correct for other similar heads, but provide a field for the experimenter who is able to check on the change in response which would follow any variation.

Thus, it will be seen, that the compensation for recording is distributed throughout the entire circuit so that no section of it is called upon to supply an unreasonable amount.

In the playback position, the compensation is carried still further and the final step-up is achieved.

This is provided by the bass boost condenser which is still in circuit.

No additional high frequency boost is carried out on playback. Any such process can only boost tape noise as well, and might cause high frequency oscillation, which is, perhaps, the greatest danger we have to watch, not so much because of circuitry, as the necessity for bringing so many touchy leads to a common change-over switch.

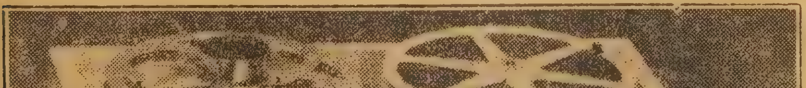
The need for bias in recording has been exhaustively covered in earlier articles — our concern here is with the method of obtaining it.

The oscillator need not be very high-powered, as there is no erase head to worry about. We want something like 120 volts of bias (measurable only with a HF indicator) for the head, and a circuit as free as possible from harmonics. A push-pull circuit is preferred for this reason, with a separate output winding for head connection. The head of the unit used is tapped for the connection of this bias to provide some measure of isolation from the output circuit.

"DIE AWAY" CIRCUIT

Note that a .005 mfd condenser is connected at this point. When changing across to playback, the charge on this condenser leaking away through portion of the head winding, allows a gradual decay of potential (known as "die-away") to make sure the head is not left in a magnetised condition. The action of the switch causes a sharp pulse to be fed to the head, which may leave it magnetised without this precaution. A head in a magnetised condition plays back with a high noise level quite similar to that from a piece of tape which has not been properly demagnetised. In fact, both conditions are highly analogous.

One of the weak points about all but elaborate recorders is the necessity for switching the input from the various sources of signal in the record position to the head in the playback position. As in the interests of simplicity, a signal switch is used for the changeover, we must take great care to isolate those circuits which might interact with each other and cause feedback and/or oscillation.



Here is the complete recorder with the amplifier mounted under the motor board and the recording unit in place. The motor is a 15-year-old 2-speed Paillard which works perfectly, giving two recording speeds. The pickup can be used to copy discs using the same turntable.

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That is why the switch used has wafers which are spaced well apart, and a shield placed after the input section. The overall gain of the amplifier is much higher than that normally used with pickups, and we must, therefore, be careful. That is why provision is made to earth unused wiring associated with the switch, and certain leads are shielded or strategically placed to avoid feedback.

A separate diagram is included to show which of the switch positions is used for each function. If you follow out this scheme, you should not strike trouble. Each wafer is a 3 x 3 type, but obviously we have no use for some of the sections and contact points.

We spaced the wafer sections on a couple of 3in bolts, anchoring them between nuts and spacers. Any convenient method of spacing can be used which prevents the two rear sections from fouling the first valve socket and the output socket. These are a little closely fitted, but leads are shortened thereby.

LEVEL INDICATORS

Two volume indicators are provided, using midget neon lamps. Those we used are obtainable in moulded mounts ideal for the job, but they must be obtained without the series resistors. One of them flashes when signals of low volume are being handled, and the other flashes near the overload point of the head. The neons are the simplest type of volume indicators, and the easiest to interpret.

When the overload neon flashes it places a top cut circuit (.025+.005) across the output which causes a slight drop in highs. This isn't serious on "record," but it can be switched out for playback.

One section of the rearmost wafer accomplishes this, and it is important that the connection to the output circuit is made not to the "common" lug of the section, but to the single contact lug in the "record" position. Oscillation may occur if the connection is wrongly made. The "operate" neon will not cause distortion as its series resistances are too high in value to shunt the output.

A magic eye indicator would be free from this loading effect but is harder to interpret than the neons. A meter is by far the best method, but would require an extra valve to operate it.

MONITORING

The speaker connection is made via a separate switch for a definite purpose. While it is possible to record quite well with the speaker connected, it is generally at far too high a level for comfort. A monitoring position at reduced level is essential, and recording should always be done this way.

When monitoring, provision is made to wire a resistance in series with the speaker having a resistance about 10 times that of the voice coil. The practice of substituting a resistance of equal value to that of the voice coil should not be used in this circuit. If it is, it will effectively tie the output plate load down to a fixed value, and the output impedance cannot rise as it should do if the boost circuit in the feedback loop is to operate.

In the third speaker switch position, a high value resistor is wired across the voice coil winding and the voice coil itself is disconnected. This position is mostly used to prevent feedback with a microphone.

A little ingenuity allows a single input socket to be used for radio, pickup or microphone. On radio, a voltage divider is used consisting of a 1 meg. and a .02 resistor in series to reduce the input voltage so that the first 6AU6 grid will not be overdriven. The radio connection may generally be made across the diode load or to a tap upon it.

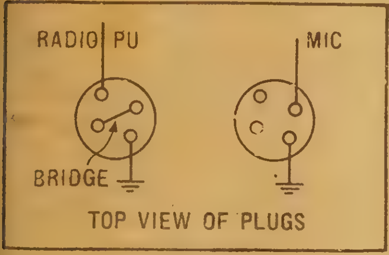
A pickup which will normally use a compensating pad may be fed into the 1 meg. load on the socket. The microphone is fed so that the 5 meg. resistor is its load.

The appropriate bridging to achieve these connections is made in the plugs themselves and a wiring diagram herewith shows how it may be done.

To avoid hum pickup at the input plug, a small shield may be made from aluminium or tinplate, totally enclosing the back of the plug and the resistors. We have not found regular microphone plugs and sockets to be essential and they are costly. All input leads should be shielded right up to their plugs and kept as short as possible.

A top-cut tone control is provided which operates on the feedback loop.

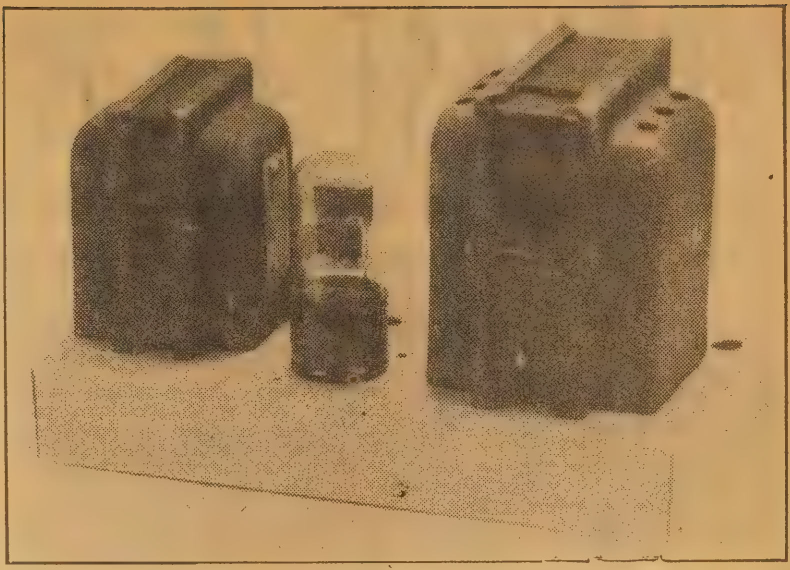
No trouble should be experienced if our layout is followed, although it is not necessarily the only one which will work well. Shielded leads include the lead from the input grid to the plug, all those leads which run through the switching to the head connection, and the output lead from the bias coil. The coupling condenser to the volume control can be a metal-canned type with the can earthed, as this plate connection is another "touchy" spot.



Normally inputs may be made by connecting plugs as shown here. Most pickups will need compensation, however, which is best done externally. in such cases, the 1.02 meg. load input will be most useful.

Our layout allows for a short lead from the first grid through a hole in the shield to the switch, and for short leads right up to the input grid of the second 6AU6. After that point things are not so critical. The T-pad should be mounted close to its switch section, again to keep leads short.

The 24 mfd decoupling condenser is mounted above the chassis where there is plenty of room. The .5 bypass on the first 6AU6 screen is rather a big item, although miniature components are available and should be used. A small condenser of .1 mfd is much easier to fit, but drops response about 3 db at 50 cycles, which become 6 db by the time we play back. A smaller value isn't so important on the second valve as the feedback tends to compensate for any drop.



The power supply is built separate from the amplifier.

The head is connected to the unit through a shielded lead, as is the bias connection. The braid should be earthed at the amplifier, and not the deck. Earthing of the deck and the motor should be done with a separate earth lead to the amplifier.

(Continued on Page 103)

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A COURSE IN TELEVISION

PART 42 — LARGE SCREEN SYSTEMS

A phase of television which is assuming increasing importance overseas is that of a large screen or theatre television. Since the requirements are not exactly parallel with those of home entertainment there are a number of problems peculiar to this phase of the art. Some of them are discussed in this article.

THE two main problems are the provision of adequate definition, realising that it will have to stand comparison with regular film projection, and the provision of adequate light satisfactorily to illuminate a large theatre screen. This is also likely to suffer by comparison with films if it is not of a reasonable order.

Since the quality of definition is governed mainly by standards adopted for a particular system there is not a great deal that can be done to improve this by means of any particular projection system. Thus, there need not be a great deal to choose between the various systems in this regard, the factors of economy and convenience being generally more significant.

DEFINITION

To appreciate the definition problem properly it is necessary to realise that the definition provided by a 625-line system (the proposed Australian standard) is very much less than that provided by a 35mm film system and, in fact, is barely equal to the average 16mm system. Anyone who has seen 16mm movies enlarged for projection on a standard theatre screen and been able to compare them with normal 35mm images will realise that there is a considerable loss of quality.

If this were the only factor involved, it would probably be sufficient to pay careful attention to camera technique, with adequate use of close-ups, to provide perfectly satisfactory entertainment. The real snag is the line structure, of which the picture is composed, and this brings us to a consideration of important differences between domestic television and theatre television.

In the home, the number of viewers would be small, probably no more than five or six on an average, and there would be no difficulty in accommodating them all at a near-optimum distance from the screen. This is usually given as so many times the height of the screen, depending upon the standards of definition, and is designed to place the viewer as close as possible to the screen, in order to see as much detail as possible, without being able to see the actual line structure.

In the theatre the position is vastly different. Because 35mm films give much higher standards of definition, it has been found quite practicable to seat viewers very much closer to the screen than is possible with television and, even though these seats are not regarded as the best, they are still capable of providing reasonably satisfactory entertainment.

To provide the same order of definition with a television image it would be necessary to reduce the size of the picture to the point where patrons in the back of the theatre would not be adequately served.

Since, to the average viewer, the quite definite nature of the line structure is much more objectionable than the far less definite defect of simple loss of definition, those close enough to the screen to see the lines obtain a very poor quality image.

EYE FAILURE

In many cases the situation is made even worse by certain characteristics of the human eye. One of these causes what is known as "stroboscopic twining," an effect only noticed when the viewer is close enough to see the line structure. The effect, to the eye, is exactly the same as if the interlacing system had failed and was locating adjacent lines of each pair in the same position. Thus, the effective number of lines in the picture is halved.

It is for this reason that many workers have experimented with schemes providing spot wobble or spot elongation and, although there has been much argument as to whether these schemes improve definition or not, they would seem to provide some definite advantages.

In fact, they are not intended to improve definition, nor can they be expected to, since this is determined by the number of picture elements available in the system. What they are intended to do is to eliminate the obvious line structure and thus make the picture acceptable, within the definition limits of the system, at a much closer viewing distance.

It may well be that higher standards of definition will eventually be necessary for theatre television if complete programs are to be handled in this way and if they are to compete with modern high quality film projection. In this respect the situation would be parallel to the present movie techniques where eight and 16mm films are found to be adequate for home entertainment but the larger 35mm is necessary for the theatre.

For the present, however, theatre television has been largely limited to the presentation of special events, such as sporting fixtures, events of historic or national importance, &c, and which, in the normal way, could only be seen by a relatively small audience. In these circumstances, the loss of definition is largely offset by the importance of the subject matter and, providing the screen is well illuminated, the present standards are probably adequate.

This brings us to a consideration of the various illumination problems and the ways in which they have been attacked. There appear to be three broad classifications into which theatre systems may be grouped, some of which may be further subdivided, and which are listed as follows:

1. The direct projection system.
2. The intermediate film system.
3. The modulated light beam system.

DIRECT PROJECTION

The direct projection system may be subdivided into the refractive and reflective systems, the refractive system most nearly resembling standard motion picture techniques. The basic principles are shown in figure

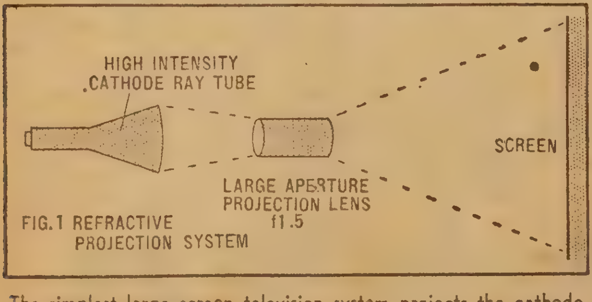


FIG.1 REFRACTIVE PROJECTION SYSTEM

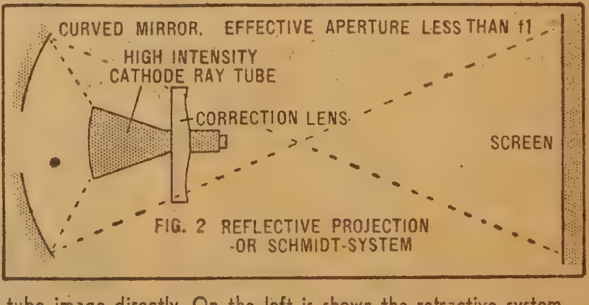


FIG. 2 REFLECTIVE PROJECTION OR SCHMIDT-SYSTEM

The simplest large screen television system projects the cathode ray tube image directly. On the left is shown the refractive system, which uses a large aperture projection lens. More light is provided by the reflective system which uses a mirror and correction lens, but production of the latter item is difficult.

1, where it will be seen that the television picture tube simply takes the place of the illuminated film in standard optical projection system.

Although basically simple, the scheme has the disadvantage that much of the available light is wasted and, since there is never any to spare, this is a serious limitation. The use of large aperture lenses, up to f1.5, is generally necessary if a reasonably bright image is to be obtained.

Special tubes have been developed for this class of work and are generally small in size, having screens only a few inches in diameter, and designed to operate at very high voltages, sometimes as high as 30,000, in order to provide the maximum possible amount of light from the fluorescent material.

TUBE LIFE

It is possible that the life of these tubes could be a secondary consideration when the finances of a large commercial project are concerned, since the cost of replacement after only a few hours service could still be an economical proposition where a large box office turnover was involved.

The other projection system, the reflective system, uses a combination of mirrors and lenses which has come to be known under the general heading of the Schmidt system—after the man who invented it. The general principles may be grasped from figure 2, where it will be seen that the light rays from the cathode ray tube, which faces away from the screen, are reflected from the surface of a large curved mirror.

This mirror alone is capable of projecting an image, and a picture will be obtained on a screen placed at the correct focal plane. However, a sharp all-over picture cannot be obtained on a flat screen and when this system is used for astronomical photography it is customary to use specially curved plates or films. When a flat screen is to be used it is necessary to use an additional optical element, a correction lens, in order to retain a sharp image to the edge of the screen.

The advantage of the Schmidt system is greater efficiency, effective lens apertures better than f1 being completely practical, and the importance of this can be better appreciated when it is realised that an aperture of f.75 would pass four times as much light as one of f1.5. On the other hand, the practical production of the correcting lens presents a problem, since its shape is aspherical, that is, it does not follow the simple spherical shape used in normal lens technique.

HAND GRINDING

Originally this meant that such lenses could only be produced by laborious and costly hand-grinding methods, but the latest technique is to mould them in a suitable plastic material, making possible quantity production at a low cost once a suitable die has been produced.

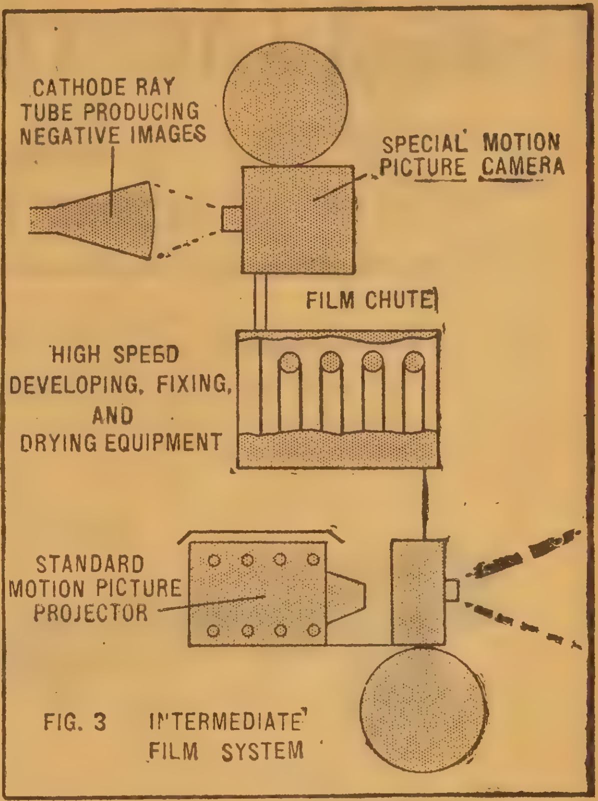
Although both the refractive and reflective systems have been used extensively, it is still extremely difficult, or even impracticable, to produce full-size theatre images which are of comparable brilliance to normal motion pictures.

It is often necessary, therefore, to compromise on both the size of the picture and the brilliance and, while these limitations may be acceptable while an element of novelty remains, it is not likely that they would be satisfactory where it is planned to distribute entire programs, lasting several hours, from the central point to a number of theatres.

THE INTERMEDIATE FILM SYSTEM

In the intermediate system the cathode ray tube is photographed, the film processed in less than one minute, and projected in the usual way. The system gives excellent results but is costly to run except for special programs. Difficulties in recording the sound on film are being overcome by using a magnetic track on the film edge.

☆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STANDARD MOTION PICTURE PROJECTOR

FIG. 3 INTERMEDIATE FILM SYSTEM

Another approach to the problem is the intermediate film system, the general principles of which are shown in fig. 3. The image is reproduced on a standard cathode-ray tube screen, photographed by a motion picture camera, processed at high speed, dried, and fed to a standard motion projector and projected in the normal way.

PLENTY OF LIGHT

The advantage of such a scheme, of course, is that there is virtually no limit to the amount of light which can be used for projection and, in this particular respect, the image would be equal in quality to standard motion pictures. The disadvantages of the system are: Extremely complicated equipment, a definite time delay between the actual event and its presentation, and a very high running cost.

One problem is the difference between the frame frequency of television images and motion picture projection. Motion pictures are now made to a world standard of 24 frames per second, while television systems usually adopt a standard which will fit into the power supply frequency adopted as standard in that particular country. Thus English, European and proposed Australian standards are 25 frames per second (50 interlaced fields per second) to suit the 50-cycle power supplies normally used in these countries.

The American standard is 30 frames per second due to the common use of 60-cycle power mains in that country, and this presents something of a problem where film images are to be transferred to television and vice versa.

In this respect, America is in a less favorable position than countries using a 50-cycle supply, since it is relatively simple to increase the standard 24 frames per second to 25 per second to match the television standard. The slight increase in speed of movement and pitch of sound is so small that it passes unnoticed, whereas an increase from 24 to 30 frames would be quite intolerable.

For this reason, American conversion systems are forced to use rather complicated, though ingenious, methods of scanning. The basic principle is that of scanning alternate frames a different number of times, the average of the two being equal to the television scan rate. Thus, the first frame is scanned three times and the second scanned twice, the third three times, and so on.

This calls for special motion picture equipment (the camera in the case of the projection system) which has been modified to present the alternate frames for different periods, or which employs a complicated system of lenses and shutters in conjunction with a continuous film movement to achieve the same effect.

NEGATIVE IMAGE

Since normal film processing produces a reversal of tones where only one step is employed, and it is desirable to limit the number of steps in the interest of speed, steps must be taken to ensure that the final image is a positive suitable for projection and not a negative as it would be if the normal cathode ray screen were photographed.

This is achieved quite simply by reversing the phase of the video signals fed to the control grid of the tube, resulting in a negative image on the tube face. When this is photographed and processed once it produces the required positive film image.

(Continued on Page 99)

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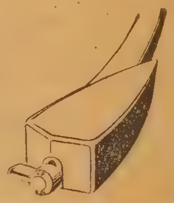

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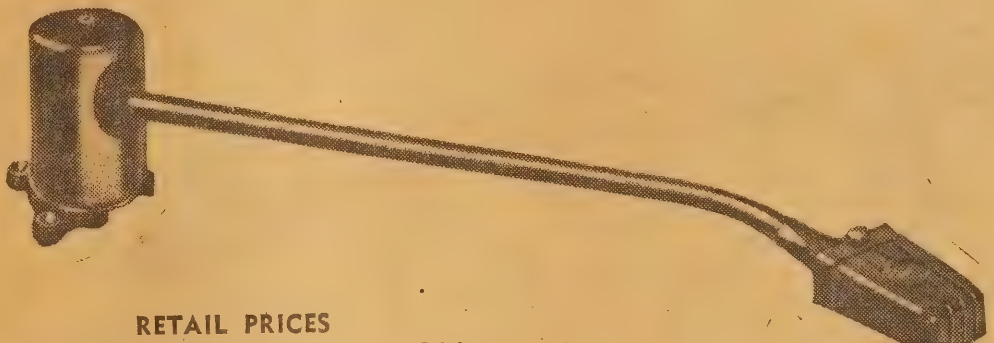

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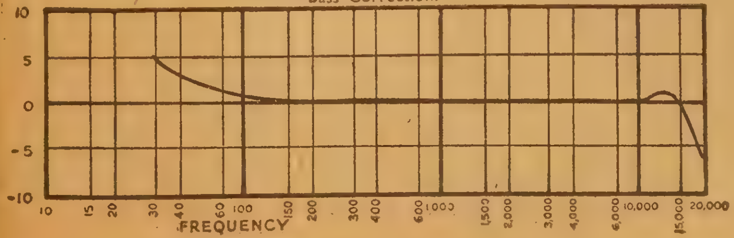
OLD TYPE	.0035 inch	ORANGE
LONG-PLAYING	.0010 inch	RED

FREQUENCY RESPONSE CURVE. 0·0025 inch Radius Stylus, 30kΩ Load, Bass Correction.



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COMPENSATING CRYSTAL PICKUPS

For some months we have been inundated with requests for the design of a compensating pad for modern crystal pickups, in particular the Acos GP20. This article discussed the general problem and suggests a special pad which can be used to couple the GP20 to a high-gain compensated amplifier.

by W. N. Williams

IT would appear, for the time being, at least, that lightweight crystal pick-ups are the most popular choice in the ordinary domestic record playing field.

There are two main reasons for this.

The first is that their high output and sustained bass response allow them to be used with conventional "flat" amplifiers. The gain is usually adequate and no special compensation is required, even for playing microgroove records.

NOISE PROBLEM

A second point is that the popular cantilever stylus has proved very reliable mechanically, and it produces very little acoustic output or "chatter" off the surface of the disc.

The same cannot be said of many magnetic pickups which have appeared on the local market.

Electrically, however, the cantilever pick-ups are by no means ideal, their frequency response curve being rather eratic in shape. But since the reproduction generally is better than from most of the older pickups, the results are acceptable to the majority of radiogram owners.

More discriminating listeners, however, may notice that the surface noise, in some cases, is more obvious than it should be, considering the overall frequency response. The question therefore arises as to how the pick-up can be compensated to minimise this noise without having too drastic effect on the frequency response—in traditional terms, "How can one instal a scratch filter?"

As we have pointed out on previous occasions, the predominance of scratch (or surface noise) in a pick-up's output is a fairly certain indication of a response peak in the upper middle register.

The job of a scratch filter (or compensating pad) is to cancel this peak and produce an overall response curve which is more nearly level.

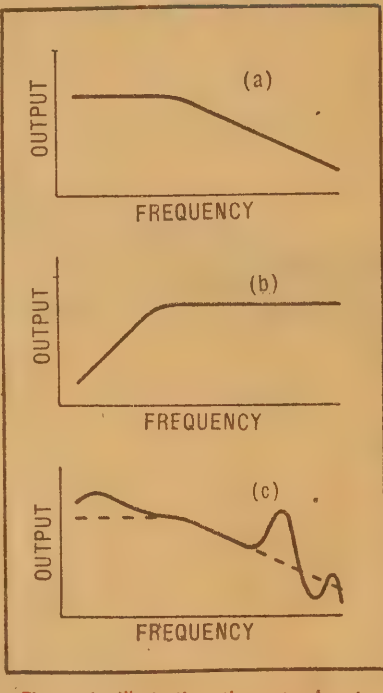


Figure 1: Illustrating the natural output of a crystal (a) and a magnetic pickup (b), showing the influence on the former of mechanical resonance.

Numerous attempts have been made over the years to make a simple absorption (or "scratch") filter which will work as readily with crystal pick-ups as with magnetics. However, most of these filters have met with only indifferent success, even with the particular pick-up for which they were designed.

The plain fact of the matter is that crystal pick-ups are difficult to compensate in this way, especially if it is desired to preserve their full output and bass response.

A common experience is to examine the initial response curve of the pickup in question, then set about designing a filter which will have complementary characteristics. Unfortunately, when the two are put together, the overall result is likely to be anything but linear!

The reason for this is not difficult to discover. From the output side, a crystal pick-up looks like an almost pure capacitor of rather uncertain value. When connected to a compensating network, the pick-ups own capacitance resonates with the constants of the filter to produce a secondary set of peaks and troughs.

INTERACTION

This calls for a re-shuffle of the filter constants to shift these secondary peaks, whereupon the initial peaks and troughs again become evident, a helpless business.

The interaction can be limited to some extent by severely loading the pick-up or by isolating it from the "L" and "C" components with a resistive pad. The immediate result, however, is to reduce greatly the available signal voltage and, generally to prevent the natural rise in bass response—and these are the very features that one may wish to preserve!

It is not surprising, therefore, that most of the simple resistive networks suggested by the pick-up manufacturers serve only to re-shape the general contours of the bass and lower middle register, without affect-

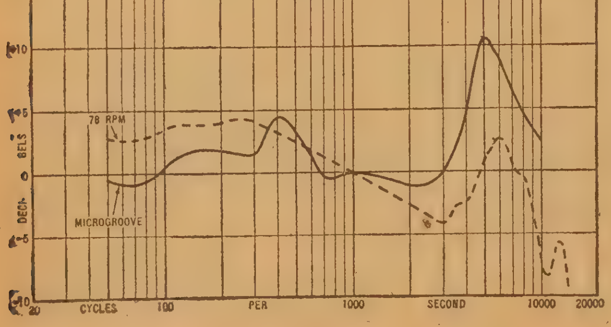


Figure 2: The actual output from two Acos GP20 heads across a 0.5 meg load from standard 78 and 33 rpm test records. Important requirement is to cancel the 5-6 Kc peak.

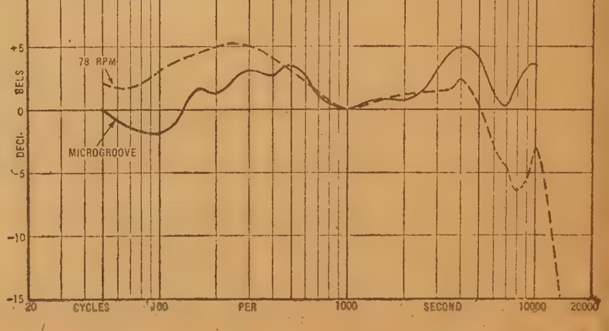


Figure 3: Equivalent curves for an early "Chancery" type head. More recent tests show the 4-5 Kc peak to be lowered somewhat and the 8-10 Kc peak to be increased in amplitude.

ing at all the treble peak (or peaks).

If the reader is keen to pursue the matter of compensation to its logical limit, it may just as well be on the understanding that the signal voltage ultimately available may not be substantially different from that to be expected from a lightweight magnetic pickup. Therefore, the amplifier may need to exhibit the same high sensitivity and, perhaps, the same facilities for bass boosting.

At first glance, this position may seem rather ludicrous, leading to the obvious query . . . "Why not use a magnetic in the first place and be done with it?" And the contention is perfectly legitimate, provided you can buy a magnetic which will be just as cheap and reliable mechanically as the crystal and exhibiting a natural response comparable with the crystal after compensation.

However, the intention here is not to make a case for one type or another but simply to assume that many readers have lightweight crystal pickups on hand and may wish to experiment with compensation for them.

Well, then, let's get down to fundamentals.

A crystal pickup may be regarded as a capacitive generator whose output voltage is firstly proportional to the amount by which the piezo element is flexed. In other words, its output will tend to follow the amplitude-versus-frequency characteristic to which the original recording conforms. (Note the word "amplitude").

TYPICAL FIGURES

Thus, taking a British standard disc as an example, the natural output from a crystal element conforms to figure 1a. The response is level below the 250-cycle turnover point because the amplitude of recording below this point is constant. Above 250 cps, the output tends to fall because the amplitude progressively reduces as the frequency rises.

By contrast a magnetic pickup is "velocity" conscious and its natural output law follows the trend shown in figure 1b, the bass response falling away below the turnover point and the treble response remaining substantially level.

In the case of a microgroove disc, with its pre-emphasised treble response, the amplitude of cut is more nearly constant throughout the range and a crystal pickup therefore tends to a fairly level output.

A magnetic pickup, conversely, exhibits the falling bass and steeply rising treble, proportional to the frequency/velocity characteristic of the disc.

In other words, there is a fundamental difference between the behavior of a crystal generator and a magnetic generator and, on this score alone, one must expect some variation in their exact compensation requirements.

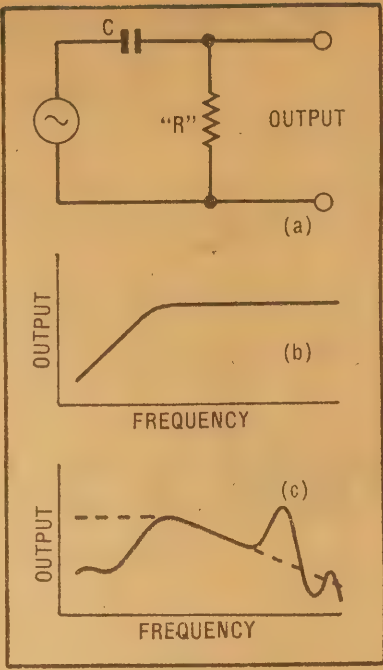


Figure 4: Simplified equivalent of crystal coupling circuit and its response (b). Combination of 1c and 4b gives the result in 4c. Check against actual response curves.

Of course, no practical pickup follows the idealised curves of figures 1a (or 1b). In every case a rise can be expected in the 30-70 cps region due to the overall resonance of the stylus, cartridge and arm assembly. And, in the region above say 3000 cps, another rise can be expected due to the natural resonance of stylus and armature.

In actual fact, nearly all the cantilever crystal pickups, apparently due to the long stylus arm, exhibit at least two distinct peaks in the treble register. The fundamental peak occurs usually between 4 and 6 Kc, with a second peak around 8 to 12 Kc.

In the bass region, arm resonance also lifts the output markedly. The contours of this peak depend on the overall characteristics of the pickup mechanism but 4 or 5 db at 50 cycles is quite typical.

PRACTICAL CURVE

The idealised curve of figure 1a must, therefore, be modified to the general shape of figure 1c.

In general, the bass response of all crystal pickups can be controlled easily enough by resistive loading.

Treble resonance effects, however, are open to much wider variation and it is impossible to strike any approximation covering all types. It is, therefore, impossible to design any "universal" type of "scratch" filter. Let's examine the position.

Of the mass-produced crystal pickups at present available, there appear to be three major types, which can be mentioned in order. (See figure 5.)

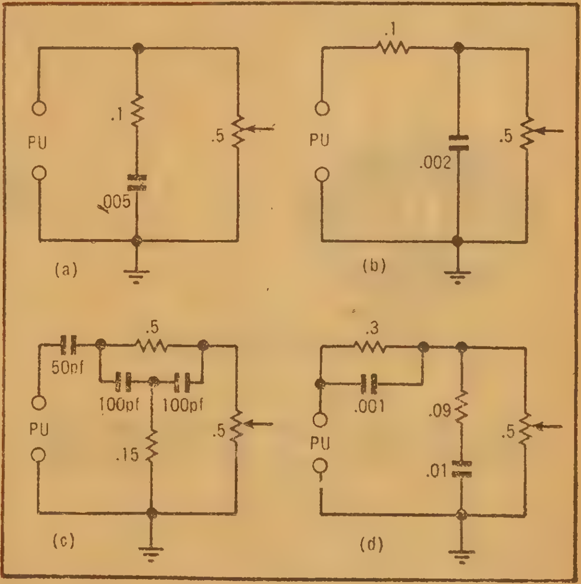


Figure 6: Resistance pad circuits suggested recently in overseas journals for the pickups shown below. Simple pad (a) is recommended for use on 78 rpm records. Simple pad (b) or more complex pad (c) is for microgroove compensation. Pad (d) is a compromise circuit for use with a turnover head on either 78 or 33 rpm records.

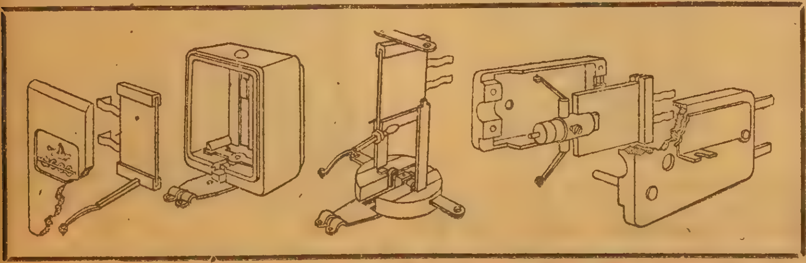


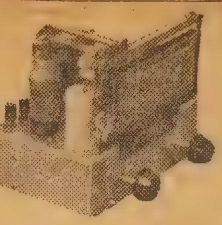
Figure 5: The physical construction of three popular types of cantilever crystal pickup. A different flexing action is applied to the crystal in each case.

First of these is the popular Acos GP20 and a variety of other makes using the same rectangular head.

As mentioned in the November, 1951, issue, the response of these heads appears to be fairly consistent and of a shape which warrants an effort at serious compensation.

Average response curves for both 78 and microgroove are reproduced in figure 2.

It will be seen that the fundamental treble resonance occurs at 6 Kc with the 78 rpm head and at about 5 Kc



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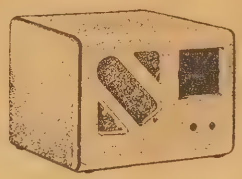

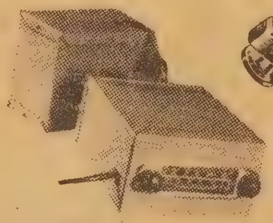

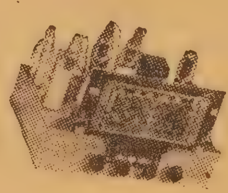

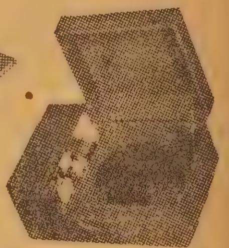

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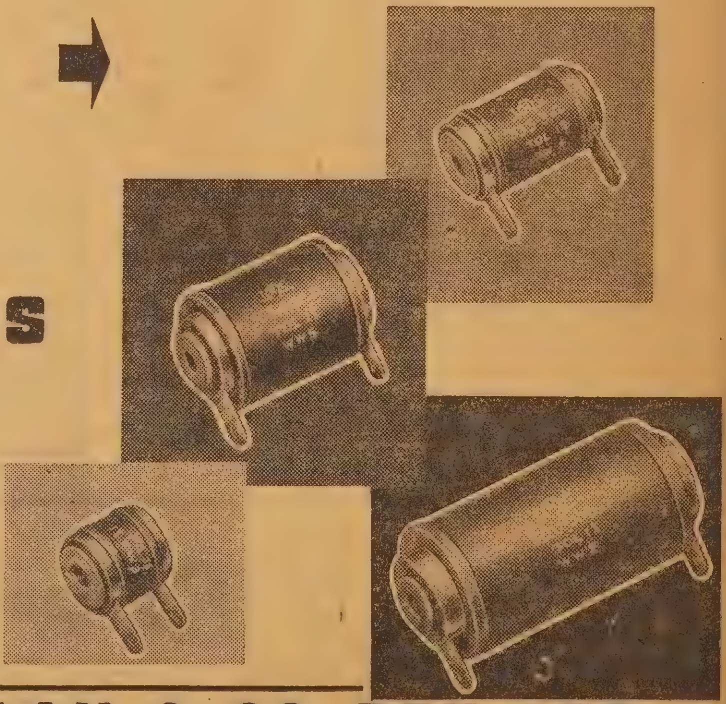


with the microgroove head. The peak on microgroove would appear at first glance to be much the higher of the wo but the effect is produced purely by the pre-emphasised characteristic, which will (or should) be cancelled n playing back.

Nevertheless, the manner in which he peak protrudes from the normally sloping treble line (dotted in c) readily explains how musical overtones and record noises are boosted over this narrow band of frequencies.

Beyond the peak, the treble response meanders downward to a virtual cutoff at about 12 Kc. but here is sufficient of it left to warrant compensation.

By way of added interest, the record "turnover" regions in the bass register can be picked in both he 78 and the microgroove curves, although they are masked somewhat by the apparent beginnings of arm resonance effect. (Compare with figs. 1a and 1c.)

"CHANCERY" HEADS

A second class of pickup, of which the Chancery is typical, uses a circular plug-in cartridge.

The earliest versions of this cartridge, as mentioned in the January, 1952, issue, exhibited a response similar to figure 3.

It shows the same general trend as the GP20 head but the additional mass of the replaceable stylus and some possible variation in damping has lowered both the position and the magnitude of the fundamental treble peak, as well as the overall treble response.

Nevertheless, a head exhibiting these general characteristics would respond favorably to much the same compensation as might be devised for the GP20 head.

Unfortunately for our peace of mind several of the Chancery type heads tested recently have shown a complete departure from the characteristics of figure 3. The original 4 Kc. peak has been further reduced in magnitude and the secondary 8-10 Kc. peak made more prominent, giving a smoother overall result.

The bass response and arm resonance show up more prominently, however.

DUBIOUS VALUE

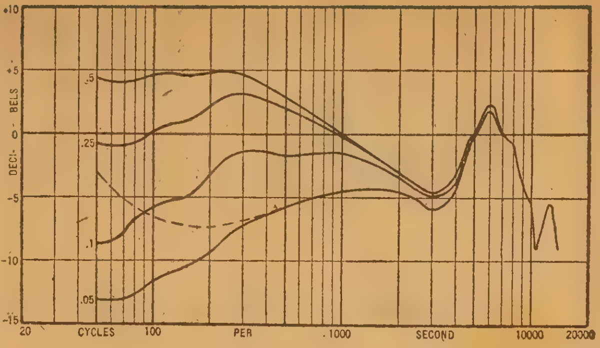
It is doubtful, in a case like this, whether there is much to be gained by trying to compensate the individual peaks, unless it is done purely as an individual effort on individual pickups. It would seem to be wiser to accept the treble response as it is and merely modify the general balance of the curve by one or other of the resistive networks suggested by the manufacturers.

One thing is certain, namely that the pad suggested later for the GP20 would be worse than useless, leading to a colossal peak in the 10 Kc. region.

Thus, if you have a Chancery or similar pickup and are not in a position to check its initial response, then the only possible course of action is to try it with the various filters and judge results for yourself.

The same uncertainty surrounds several Continental pickups we have tested recently—Dutch and German.

Figure 7: These curves show the actual output from a GP20 78 rpm head when fed into differing values of load. Note the obvious record turnover point shown for 0.5 meg and the 250 cycle bump with loads between 0.1 and 0.25 meg. The bumps disappears with lower values of load.



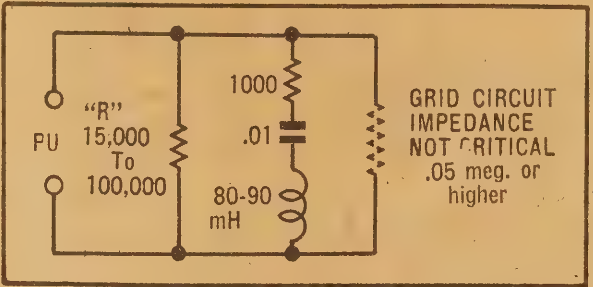


Figure 8: Designed especially for the GP20, this absorption pad eliminates the treble peak and boosts the output around 10 Kc. Used with a compensated amplifier and with "R" equal to 15,000 or 20,000 ohms, the response would be as shown in figures 10 & 11.

For the most part, the designers appear to have favored rather heavy damping—and multiple treble peaks—apparently with the idea of having them sound pleasantly "mellow" when fed straight into the pickup terminals of an ordinary set.

Neither scratch nor overmuch treble should be a problem with most of these pickups.

The third class of pickup requiring mention is the turnover type having two complete stylus assemblies connected to a single crystal.

We have only tested one or two of these but, as expected, the extra mass of the idle assembly lowers the first treble resonance to about 2 Kc. Above this figure, however, we found a variety of peaks and troughs arising apparently from the free stylus which is, of course, not in contact with the disc.

In certain spots distortion was evident and a tendency to groove skating—though this could have been due purely to stylus shape.

All in all, however, the impression formed by the writer was that the "turnover" pickup, while handy in the domestic sense, is not sufficiently predictable in its characteristics to warrant special efforts at treble compensation. But by all means try the R/C pad suggestion in figure 6d.

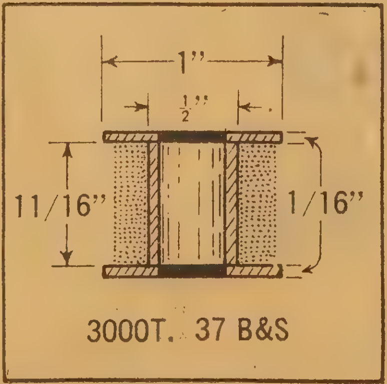


Figure 9: Here are the winding details for those who may wish to wind their own filter coil. Wind carefully to avoid shorted turns, which affect inductance.

So much for the pickups themselves. However, before passing on, there is one other factor which must be considered, namely the effect of resistive loading on the pickup's output.

EQUIVALENT CIRCUIT

Greatly simplified, the equivalent circuit of a crystal pickup is as shown in figure 4a, where "C" is the effective capacitance of the pickup head—typically about .0025 mfd.—and "R" is the total, effective resistive loading.

The response from such a circuit is as shown in figure 4b, the turnover point being determined by the relationship of C and R.

When R is large in value, say 0.5 megohm, the roll-off point occurs quite low in the range—around 100 cps. Any drop due to loading is likely to be more than offset by arm resonance effects and so on, so that a crystal pickup operating into a 0.5 meg. load normally sustains its output down to at least 50 cps.

Progressively lower values of load, however, push the roll-off point higher in the range, as revealed by the curves of figure 7. This point has to be considered, because most practical compensating pads impose on the pickup a much lower total resistive loading than 0.5 megohm.

What then happens is that the downward slope due to the coupling network (fig. 4b) intercepts the opposite slope due to the pickup (fig. 1a) to produce a result equivalent to figure 4c.

The apparent peak thus created, generally around 500 cps, is often further aggravated by the onset of arm resonance effects, and a "400-cycle bump" is a common feature of crystal pickup response curves.

In actual fact, we examined care-

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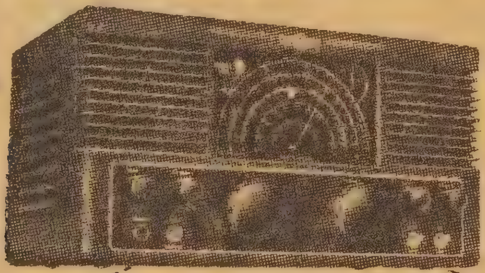

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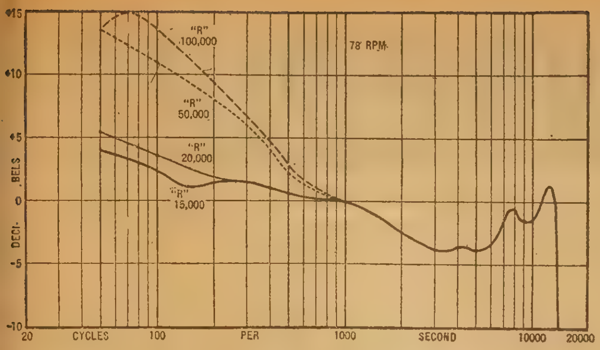

Figure 10: Natural response of the GP20 head operating into the filter of figure 8, and corrected for recording characteristics. The droop around 5000 cps was less evident from another test record, showing exact results depend on groove shape, &c. The 13 Kc. peak is unimportant with ordinary speakers.

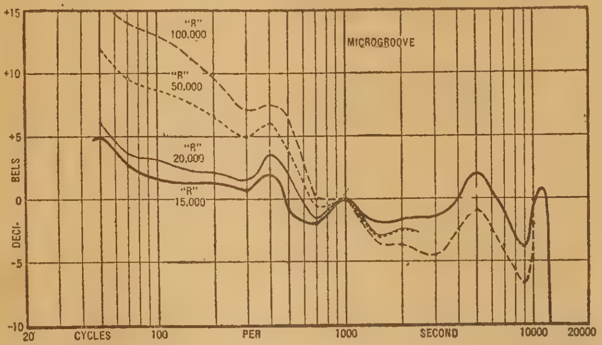

Figure 11: Equivalent microgroove curves. Heavy "15,000" curve would be result obtained through "Playmaster" control head. Higher value of 'R' would be selected if no bass boost were available. In either case, the amplifier needs high overall gain.

fully the GP20 curves of figure 2 and started to dream up a filter which would put a dip in the region around 400 cps, boost the 2-3 Kc. region slightly, cut sharply at 5.5 Kc. then rise again to boost the dwindling output up around 10 Kc.

The result was a bridged-T followed by a damped L/C absorption filter—the whole thing so complex and "lossy" that we promptly abandoned it. The arrangement finally adopted is, by comparison, simplicity itself.

The pickup feeds first into a fairly low value of load resistor which helps to shape the bass response.

SERIES CIRCUIT

The remainder of the filter is a simple series absorption circuit, comprising a 1000 ohm resistor, a .01 mfd. condenser and a whistle filter coil of nominal 100 millihenry inductance. We won't try to argue about the choice of this inductance, the vital point being that 100 millihenry whistle filter coils are available from most manufacturers.

You can thus buy one ready-made or wind up a coil yourself to our standard specifications. Optimum inductance for the GP20 filter occurs with the iron slug screwed out of the coil as far as it will go. In the case of the homemade coil, the slug is simply not used. The inductance in either case should land very close to 85 millihenries.

To compensate a head showing a 4-5 Kc. resonance, the slug should be screwed in to its limit in the commercial coil, or simply cemented in place if you are making one up by hand.

The physical shape and size of the filter doesn't matter much and, using a shielded commercial coil, it can be assembled quite easily on a resistor panel to "hang" in the pickup lead.

An unshielded coil will pick up some light hum, however, and the whole thing can be dropped to advantage inside any kind of metal can. Don't crowd the coil too closely or you may markedly reduce its inductance.

Use of the filter drops the pickup's output to around the nominal 100-millivolt level so that the amplifier must have high overall gain. The loading resistor "R" controls the bass response, however.

If you plan to use the pickup with an amplifier compensated for a magnetic unit, as with any of the "Playmaster" or "Lightweight" series, then a tapered bass response will be required. In this case, the load resistor "R" can be made about 15,000 or 20,000 ohms, and the pickup with its filter will behave almost exactly as would a magnetic.

If the amplifier has no provision for bass boosting, but plenty of gain, then use a value of about 70,000 or 100,000 ohms for the load resistor "R."

RESPONSE CURVES

The complete story is told better by the curves shown in figures 10 and 11. Both curves show the inherent response of the pickup and filter and do not include the characteristics of the recording, which have been added to the meter readings.

In both cases, the response is shown to be substantially level when "R" is made equal to 15,000 ohms (heavy curve). Full compensation in the amplifier for the recording characteristic will lift the overall bass response slightly above reference but this is not likely to cause any misgiving. Most important, there is not ugly 4 or 5 db bump around 400 cps with the low value of load.

In the treble register, the smoothing effect of the filter is obvious, the one large peak around 5 Kc being replaced by a somewhat irregular but much more acceptable curve from the viewpoint of noise and frequency response. On listening tests, the difference is little short of amazing.

Where there is no bass boost provision in the amplifier, the load resistor "R" can be lifted to advantage nearer to 100,000 ohms. The rising

(Continued on Page 99)

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MORE ABOUT THE ELECTRO-FLASH

This month we have some more interesting points about the electronic flash unit. There is a discussion on midget accumulators, operation from the mains, the result of tests with D76 developer and some notes on taking high-speed shots.

by Philip Watson

AS we mentioned in our original photoflash article, the requirements of individual photographers vary considerably and there are many possible variations of the original design. Two very popular ones appear to be operation from accumulators or the AC mains and we propose to discuss some aspects of these in this article.

Operation from an accumulator does not involve any major changes in circuitry but a few words about the type of accumulators available may be in order. Some readers have suggested using a motor cycle accumulator and are apparently quite prepared to accept the disadvantage and inconvenience of increased weight and bulk, together with the usual risk of spilt electrolyte, &c.

DRY ACCUMULATORS

A far better proposition appears to be the use of a much smaller 4-volt accumulator, preferably of the "dry" type, which can be classified as portable in the same sense as the dry batteries. This practice has been followed extensively by commercial manufacturers and gives excellent results.

Transformers for use with a 4-volt input are readily available from several manufacturers and in some cases this winding is provided in addition to the original 5.2 volt winding for dry batteries. Since the additional cost is only slight this type would appear to be an excellent proposition even if you do not intend to use accumulators immediately.

Vibrators intended for 6-volt operation appear to perform quite satisfactorily from four volts and, in fact, it is quite usual for the voltage from a nominal 6-volt dry battery to drop below this figure at the commencement of a charging cycle.

This means that those who have already invested in a 6-volt vibrator can probably convert to 4-volt operation without having to purchase a new one. However, if a 4-volt unit is being made it would be better to use a 4-volt vibrator and at least one dual interrupter-type for this voltage is available, being the MSP type V6604.

Dry accumulators also appear to be readily available and we have had an opportunity to try several different types in the Varley brand, originally an English make but which, we understand, is now to be manufactured in this country. The types most likely to interest the photoflash worker are the VPT7/9X, the VPT5/7 and the VPT7/7.

The VPT7/9X is the largest and has the greatest capacity of the three, being nine amp-hours when discharged at a 20-hour rate and measuring 3 1-8in by 1 5-8in by 4¾in high, including terminals. Each cell weighs a fraction over 2lb, so that a 4-volt battery would weigh approximately 4lb. This is about 1lb more than a pair of dry lantern batteries.

SMALLER TYPES

The VPT5/7 and VPT7/7 are both 7 amp-hour capacity units, also at a 20-hour rate, and are much smaller physically. Of particular interest is the VPT7/7, which measures only 3 1-8in by 1¼in by 3 3-8 high, including terminals. Each cell weighs slightly less than 1lb so that a complete battery weighs less than 2lb, or approximately 1lb less than a pair of dry lantern batteries. They are readily accommodated in the battery compartment of the original case.

We have not had an opportunity to check the number of flashes possible from one charge but it would appear to be at least equal to that obtained from a pair of lantern batteries, and probably more.

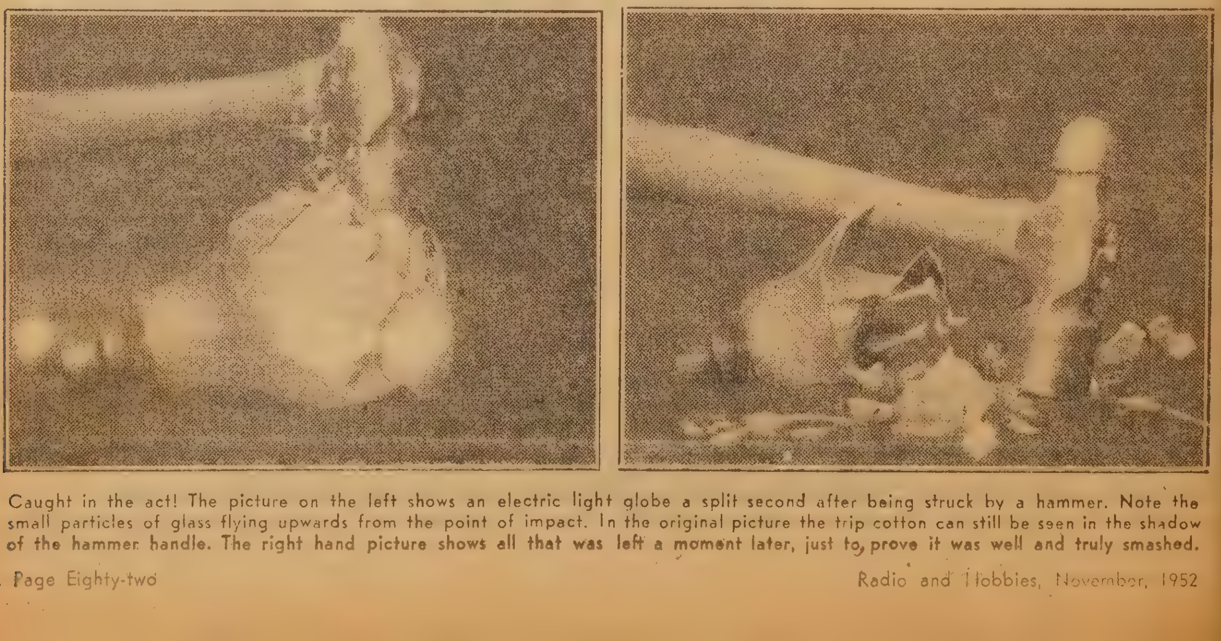
The lower internal resistance naturally results in a shorter charging time and we have suggested to the transformer manufacturers that this can be still further improved if the nominal 4-volt winding is reduced slightly to about 3.7. This allows for any slight drop due to terminal resistance, &c., or to the battery being partly discharged, and gives a faster charging rate.

WATCH THE NEON

In theory it is thus possible to charge the capacitor to more than the rated 2500 volts from a freshly charged battery but to do this it would be necessary to hold the charging button down for a considerable time after the neon indicated that the charge was complete, since the rate of charge at the end of the cycle is very slow.

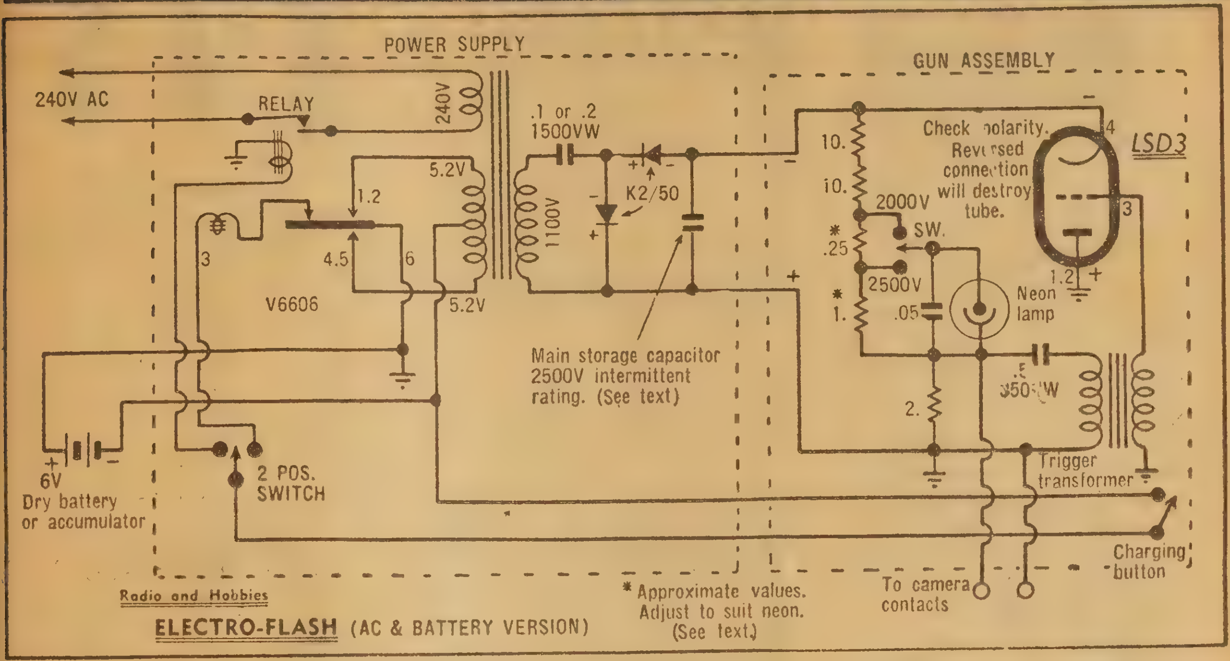
One disadvantage of the dry accumulator is that it is not possible to take gravity readings in the usual way and the condition of charge can only be assessed from voltage readings and a knowledge of the length and rate of charge.

The maker's instructions should be followed in this regard, but there does not appear to be any objection to leaving them on charge continuously at a very low rate, say between 50 and 100 mA, to offset the normal



Caught in the act! The picture on the left shows an electric light globe a split second after being struck by a hammer. Note the small particles of glass flying upwards from the point of impact. In the original picture the trip cotton can still be seen in the shadow of the hammer handle. The right hand picture shows all that was left a moment later, just to prove it was well and truly smashed.

CIRCUIT MODIFIED FOR A-C MAINS OPERATION



The modified circuit adapted for operation from the mains. The electrical changes are relatively simple but some care may be needed in mounting the relay on the original chassis. Note how the button control circuit is switched to either the vibrator or relay, as required.

internal losses common to all accumulators. This will not only ensure that the battery is always fully charged and ready for use, but also that the risk of sulphation, due to standing in a discharged condition, is minimised.

The Radio and Hobbies trickle charger recently described would be just the thing for the job.

Converting to 240 volts AC operation is not quite such a simple matter and there are a number of small problems to be overcome. Since it is unlikely that what is essentially a portable unit would be of very much value if designed for AC operation only, the most convenient arrangement would be one whereby the unit can be operated from either its own internal batteries or from the mains when these are available.

On this assumption, the transformer manufacturers have developed a transformer having both a 5.2 volt primary adjusted for vibrator wave form and a 240 volt primary adjusted for sine wave operation. The problem then presents itself as to how this can be most effectively substituted in the original circuit.

CONTINUOUS RATING

While it may appear at first glance to be a comparatively simple matter to connect the mains directly to the primary, thus allowing the charging cycle to re-commence automatically as soon as a flash has been fired, there are some objections to this. The most serious one has to do with the rating of the main storage capacitor, which, at 2500 volts, is essentially an intermittent one.

Where these capacitors are to be used in mains operated equipment and the charging voltage is to be maintained across them continuously for long periods, it is necessary to limit the operating voltage to 2000, otherwise the life of the capacitor will be very seriously shortened. However, there would appear to be no objection to the 2500 volt rating when operating from the mains, providing the same intermittent operation was observed as when working from batteries.

Thus, in addition to arranging some means whereby the connections are changed from battery to AC operation, it also becomes necessary to retain control of the charging cycle by means of the button on the gun.

By far the most satisfactory way to do this appears to be by means of a relay, operated by the charging button and controlling the main's primary circuit. Providing the vibrator is not energised at the same time, there is no objection to leaving all connections to it intact, because, although a voltage is developed across the vibrator winding, the centre reed does not connect to either side when at rest.

SAFETY CIRCUIT

To prevent the vibrator from being energised it is essential that the circuit to the energising coil be opened and since, at the same time, we must provide energy for the relay, the simplest arrangement appears to be that of switching the button control circuit from the vibrator to the relay, using a small single-pole, two-position switch.

This automatically ensures that the vibrator can never be energised when the relay is in circuit, or vice versa, and that no damage can be done if the unit is switched to batteries when connected to the mains. Thus, it is only necessary to plug into the mains and set the switch to the "mains" position.

The only objection to the scheme, and it is a minor one, is that the batteries must be retained to provide energy for the relay. In cases where the extra weight is an objection it would be possible to fit much smaller batteries, since the drain is very light.

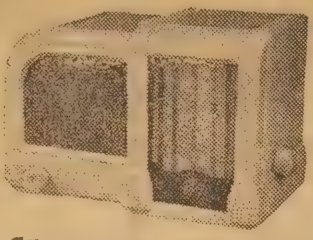
The change-over switch was a small MSP type, actually a series 20, type 23, though other types which can be accommodated in the available space, such as a toggle switch, would be equally suitable. It is mounted on the top of the chassis so that the shaft will protrude through a suitable hole in the top of the case and be fitted with a small pointer knob.

POWER CONNECTION

There is sufficient space alongside the voltage doubling capacitor to mount it and also to fit an additional three terminal tag strip to take the power cord. This is mounted on one of the bolts already holding a large tag strip. Some means of anchoring the power cable to prevent strain on these connections is essential.

Individual readers will doubtless have many types of relays to choose from, but it should be remembered that the contacts will have to operate in the mains circuit and that a breakdown could be dangerous. It was for this reason that we accepted the advice of one of the major relay manufacturers and used a unit which was fitted with a micro-switch in place of the usual contact leaves, the insulation used with the latter not being recommended for mains operation.

Although somewhat bulkier than the standard type, we still managed to accommodate it by mounting it upright alongside the vibrator with the micro-switch between the vibrator and the main storage capacitor. Since this addition was not envisaged when the chassis was originally designed some careful planning was necessary to mount it correctly. It is



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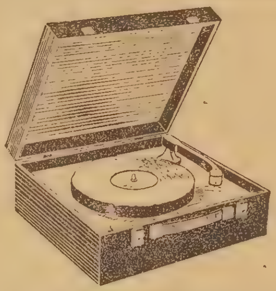

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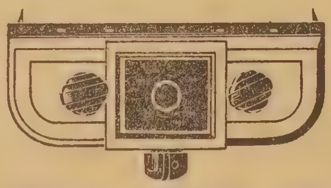

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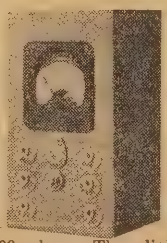

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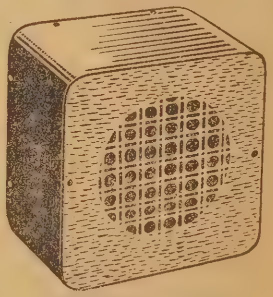

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supported by means of a small aluminium bracket attached to the chassis alongside the vibrator socket.

The relay we used was an STC type 5119AL. This is intended for 6-volt operation and has a winding resistance of 100 ohms. Thus the normal operating current will be 60 mA and the makers give the minimum operating current as 45 mA.

This figure carries a fairly wide margin of safety and we found that the relay operated quite positively on four volts. However, where a 4-volt accumulator is to be used it might be more satisfactory to use a lower resistance winding and the makers suggest type No. 5119Y, which has a 50 ohm coil and a minimum operating current of 65 mA. Both the above type numbers signify the use of a micro-switch.

So much for that. The circuit tells the rest of the story.

IMPROVED RESULTS

Since our last article we have been able to check the effect of the suggested alternative developer, D76, when used for electronic flash work. In order to provide a direct comparison between it and Microdol we exposed six negatives, commencing with a stop of f5.6 and progressing in steps of one stop to f32. The subject and distances were identical with those used for the Microdol development test described on page 90 of the September Radio and Hobbies, thus allowing these negatives to serve as a basis for comparison.

Development time was increased 50 pc above that normally recommended by the makers for this developer and when the finished negatives were compared with those processed in Microdol it was immediately evident that there had been a marked increase in effective speed. This amounted to almost two stops, which is a very considerable increase, and, in fact, it would seem that a guide number of 180 (representing two stops smaller than the previous figure of 90) could be used if absolutely necessary and where some drop in contrast could be tolerated.

For regular working, however, we would suggest a figure between 120 and 150, representing an increase of approximately one stop and one and a half stops respectively, with every possibility that the latter figure will be quite satisfactory.

Careful examination of the two sets of negatives shows how this apparent increase in speed comes about. The negatives processed in Microdol show that, as the exposure is decreased, the first apparent effect is a reduction in contrast and that this effect commences long before the effect of true under-exposure, namely, loss of shadow detail, is apparent.

D76 BETTER

Thus the so-called under-exposed negatives have every appearance of a correctly-exposed negative which has been under-developed, that is, all shadow detail is present but the contrast is too low to permit of satisfactory printing without recourse to such extreme measures as very contrasty paper or intensification.

The negatives processed with D76, on the other hand, indicate that normal contrast is retained, as exposure decreases, to a point much closer to the true under-exposure region, so that exposures which, when processed in Microdol, produce detail but no contrast, in D76 produce both detail and contrast. This effect is not peculiar to negatives exposed by electronic flash but applies to all

Varley
DRY ACCUMULATOR
TYPE
VPT 7/7

This small dry accumulator stores a lot of energy in a small space and is an ideal source of power for flash units. Note its size compared with a penny.

cases where the exposure is approaching a minimum. However, the reciprocity failure caused by the high speed flash aggravates the condition and makes it far more apparent.

For this reason it would appear that D76 or other developers of similar characteristics are most suitable for electronic flash negatives where it is still desired to keep grain to a reasonable minimum. For larger negatives higher energy developers would retain contrast with even less exposure.

It is unfortunate that the makers of D76 are unable to supply full working data, particularly exhaustion factors for consecutive development as in the case of Microdol, since it is an excellent developer and deserves to be correctly used. However, the following data, taken from the Kodak Data Book, may be of interest: The time-temperature graph has the same slope as Microdol but a shorter time, being 14 minutes for Super XX roll film at 68 degrees F. extent, so that speed ratings are of as against 16 minutes for Microdol.

The developing capacity in square inches of film per unit volume of developer is similar to Microdol, being in the order of five ounces of developer for a 120 or 35 mm roll (80 square inches), which would suggest that similar exhaustion factors would possibly be suitable. On this basis the consecutive times for developing four rolls in 20 ounces would be as follow: 1st roll, 14 minutes; 2nd roll, 19 minutes; 3rd roll, 25 minutes; 4th roll, 32 minutes. These are normal developing times and do not allow for the 50 pc increase required for electronic flash.

While on the subject of reciprocity failure, there is another interesting point to be noted. Not all films suffer from reciprocity failure to the same little value in estimating the comparative performance of different films to electronic flash. Thus, many workers maintain that Ilford FP2, normally a fine grain, moderately slow emulsion, appears to be very nearly as sensitive to this light as the normally much faster HP3.

We have not had an opportunity to make strictly comparative tests, but there appears to be ample evidence that the general statement is correct and that it provides a means of decreasing grain without serious loss of speed. This would probably be of most benefit to 35 mm workers.

As we mentioned in the September issue, it is possible to use the flash unit with cameras having the simple type of shutter without a loading lever to operate the trigger circuit. This is accomplished by fitting a contact system to the cable release so that the circuit is closed at the correct moment, the shutter being set to bulb.

We made up a simple device along these lines and the general idea of it can be gained from the illustration. Actually, it consists of little more than a few scraps of aluminium and a set of contacts salvaged from a discarded vibrator cartridge, and should be quite within the scope of any amateur mechanic with a few simple tools.

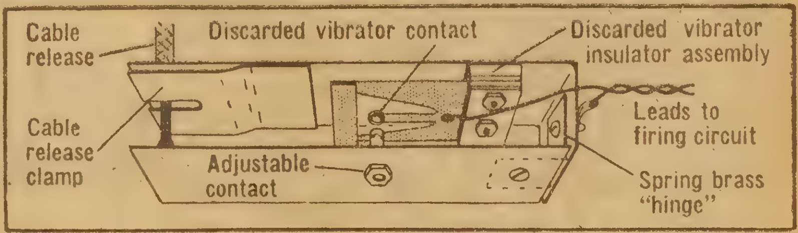
CONTACT DETAILS

The main portion consists of a strip of aluminium approximately 5-8in. wide, 3in long and turned over about ¾in at one end to form an "L" shape. Near the top of the "L" a hole is drilled to take the cable release and a smaller aluminium plate, slotted to clear the plunger of the release, is screwed to the rear of it and serves to clamp the cable release firmly in place.

Farther down the upright portion is mounted the central reed from the vibrator, the various metal and mica spacers being used to insulate it from the metal frame and also to mount it clear of the metal by about 3-16th in. A solder lug may be included in the assembly, or the wire may be soldered directly to the base of the reed.

The rear strip of aluminium is also 5-8th in wide by 3in long and is attached to the lower part of the main frame by some form of "hinge." This could be an actual hinge, or, as in our case, a strip of spring brass salvaged from a discarded cycle lamp battery. If an actual hinge is used it should, ideally, be of the spring variety, but if this is not available a short tension spring, or even a rubber band, will serve to keep the moving portion under light tension at all times.

To the moving portion is fitted the screw-mounted contact from the frame of the vibrator, being so positioned that it will meet the insulated contact when the rear portion, and



The general idea of the firing device for use with simple shutters can be gained from this drawing. Most of the parts may be found in the junk box or a discarded vibrator obtained from a radio service shop.

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hence the cable release, is pressed. The screw mounting permits the gap between the contacts to be adjusted so that the circuit closes at the moment the blades reach the fully-open position when the shutter is set to "bulb."

Having no suitable tap available to tap the aluminium frame, we mounted the screw contact by means of two nuts, but it would be possible to cut the tapped hole out of the vibrator frame and use it as a nut.

Doubtless, many slight variations of the above scheme will suggest themselves to the individual, who can make a device as simple or elaborate as his taste and facilities dictate, but the general idea should provide a satisfactory working basis.

When using this system it is important to reduce the normal lighting to a minimum to reduce the possibility of a secondary image and, for the same reason, the shutter should be operated as quickly as possible. Also make sure that the device is wired with the frame to the earth side of the triggering circuit and the insulated contact to the hot side. If the connections are reversed it will be possible to get a slight shock between the frame of the gun and the frame of the contactor, while firing may not be positive.

INTERESTING EXPERIMENT

Although generally regarded as more of a novelty feature than anything else, the ability of the electroflash to "freeze" almost any movement is, nevertheless, an intriguing one and most owners go through a period of photographing subjects which would not be possible by any other means.

While it is unlikely that this will ever amount to anything more than a novelty as far as the amateur is concerned, it should be appreciated that high-speed photography plays a very important part in modern science and industrial research, and in recent years, has solved many mysteries, ranging from the behavior of weaving looms to birds in flight, or from the performance of golf balls to the injection of fuel into a motor.

For the pure novelty of it there is no reason why the secrets of more homely functions should not be investigated by the same means and a few suggestions along these lines may be of interest.

The problem is really a mechanical one rather than photographic, because the speed of the flash will arrest almost any movement — even bullets in flight. However, it is one thing to have available a high-speed light source and quite another to be able to fire it at the precise moment necessary to get the picture required.

SYNCHRONISING SYSTEMS

Thus, to set up one's gear near the muzzle of a rifle and fire the flash as the marksman pulls the trigger is not likely to produce a picture of the bullet leaving the rifle. Probably, your chances of first prize in the lottery would be far better, simply because normal human reaction time is far too slow to keep pace with such high-speed phenomena. On the other hand, a set of contacts arranged near the muzzle of the gun and operated by the bullet would always close the circuit at the correct instant.

This, then, is the secret behind the spectacular high-speed shots, which have been published from time to time, namely, that the subject usually takes its own picture. This is not a difficult matter to arrange in most cases and once the general idea has been grasped, it only requires a little ingenuity to adapt it to a particular requirement.

WE would like to hear from those readers who have successfully built the Electronic Flash unit, in any of its forms, and to learn what kind of performance you have obtained from it. In particular, we would be interested to receive any specially spectacular pictures made with it and which may be suitable for reproduction. All details, such as subject distance, stop, number of joules, film, development &c, should be included.

A typical example is the smashing of an ordinary electric light globe (burned out, of course!) with a hammer. Such pictures reveal some interesting phases of the breaking up of the glass and the firing arrangements are quite simple.

For our set-up we arranged an upright at one end of a small wooden baseboard and a simple contact arrangement, also upright, at the other. Between the two was stretched a piece of black cotton and the tension and spacing of the contacts so arranged that they would close when slight pressure was exerted on the cotton. The globe to be broken was placed on the baseboard with the cotton just touching the top of it, and the camera and lamp was set up about two feet away and focused on the globe.

The shutter was set on "bulb," the room lighting reduced to a minimum, and an assistant handed a hammer and told to hit the black cotton hard at a given signal. The writer then opened the shutter and called to the assistant, who obligingly smacked the cotton — and the globe —with gusto, making a thorough job smashing it into small pieces. As he did so, the contacts closed and the flash fired, after which the shutter was closed as quickly as possible.

By adjusting the spacing of the contacts and the tension of the cotton it is possible to fire the flash at different phases of the action and, if enough globes were available, it would be possible to make a series of shots showing each stage of the disintegration.

We found it possible to set the contacts to an extremely sensitive con-

(Continued on Page 98)

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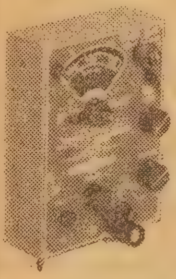

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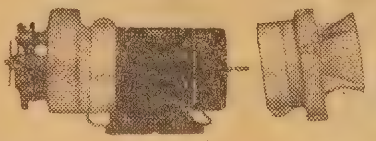

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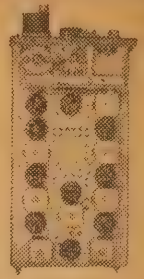

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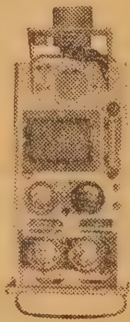

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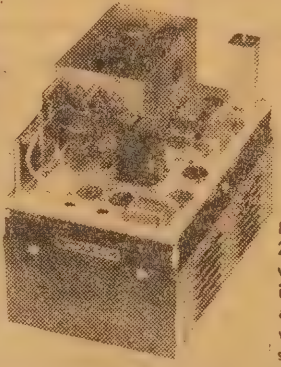

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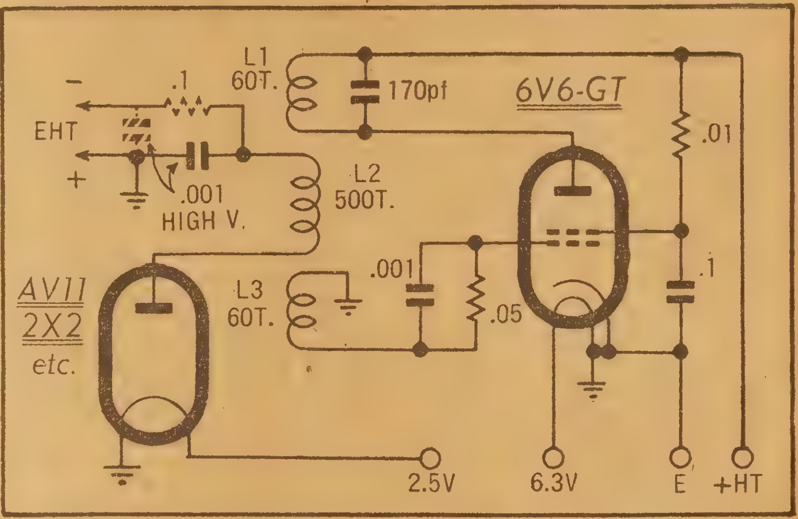
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

HIGH VOLTAGE RF SUPPLY FOR CR TUBE

There are occasions when the need for high voltage to operate a cathode ray tube presents a poser in economics for the home constructor. Here is one idea, submitted by Mr. R. Burton, of 10 Hilly St., Mortlake, NSW., which will help you out of the difficulty.



The high voltage filter capacitor rating can depend upon the desired EHT output. The filament voltage for the EHT rectifier can be obtained from a 6.3 volt heater winding through a suitable dropping resistor.

IT is an RF power supply employing very few components and yet capable of delivering voltages of quite a high order.

An RF power supply is not a new idea, having been used in some TV applications. It consists of a power valve functioning as an oscillator at a frequency around 1 Mc. The plate winding is normally inductively coupled to another winding having considerably greater number of turns. The induced voltage depends upon the turns ratio between these two windings and it can be made quite high.

The main advantages, apart from being a simple source of high voltage, is that the step-up transformer is reduced to a small physical size and the value of the filter capacitors is scaled down in proportion to the increase in operating frequency.

Step-up transformers for RF power supplies have been made available commercially and are not unduly expensive. It happened that our contributor was able to have one wound to specifications published in Radiotronics No. 117.

EHT CONNECTIONS

The high voltage winding is connected across a half-wave high voltage rectifier in series with a high voltage capacitor. This capacitor filters the rectified output which appears across it. A resistor and an additional capacitor can be used for further filtering.

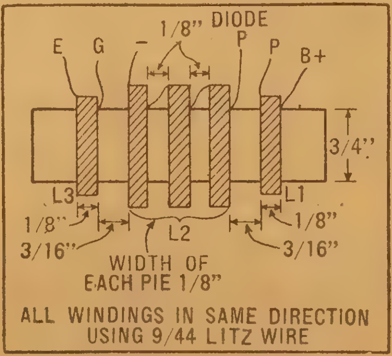
Note that the positive side of this high voltage is at earth potential in keeping with the usual technique adopted in supplies to CRT's. The rectifier is placed in the earthy side of this winding so that its filament can be supplied from the low voltage transformer without having to increase the insulation of the heater winding to which it is connected.

The 6V6GT oscillator is supplied from the low voltage power supply used for the deflection plate amplifiers and time base circuitry.

The bleed circuit from which the various electrodes of the CRT gun structure are supplied acts as the load resistance for the rectifier in the RF power supply. Naturally, the total value of this bleed circuit will set the amount of current drawn through the high voltage rectifier.

The usual drain through the EHT bleed circuit of a CRT is from .75 mA to about 1.5 mA. Unfortunately, there are no miniature rectifiers available which are rated at more than .5 mA. However, our contributor used one of these, an EY51, and adjusted the total bleed resistance in his CRO to limit the current to around the .5 mA mark.

The current through an existing bleed circuit will depend upon the voltage applied. With this RF power supply, it is possible to adjust the voltage output in a number of ways. The resistor shown dotted in the output filter can be increased, thus reducing the voltage applied to the CRT bleed circuit, or the total capacitance value across the plate winding can be increased to detune the oscillator on the low frequency side with consequent reduction in output voltage.



Design data for the step-up transformer as published in Radiotronics No. 117.

Another method would be to insert a rectifier in series with the plate of the resistor. With the miniature rectifiers, there is usually a minimum value for the series resistance of the rectifier circuit to limit the peak current through the rectifier. It can, of course, be increased from the usual value of .1 megohm to reduce the output voltage. Don't go too high, as the filtering will be reduced.

OPERATING CONDITIONS

The 6V6GT should be operated at a voltage of at least 220 volts so that there will be no doubt about its oscillating whenever it is switched on. It will draw 20 mA odd from the low voltage supply. The EHT output voltage will be just over 2000 volts with this particular step-up transformer and the value of capacitor shown across the plate winding. It can be reduced in the manner mentioned.

The unit is capable of causing in-

(Continued on Page 104)

SHORT-WAVE NOTES BY ART CUSHEN

'COURIER' BEGINS REGULAR SERVICE

The "Courier" The Voice of America's first seagoing radio station designed to break through the jamming of the Iron Curtain, began transmission on September 7th, from a location off the Isle of Rhodes in the Eastern Mediterranean.

THE Courier, a former Coast Guard cutter of 5800 tons, has been granted facilities to operate off Rhodes from the Greek Government for the next year.

The Courier operates for 5¾ hours each day on medium wave, 1394 kc, and short-wave 6015 and 7200 kc. The transmissions are 3.0-7.15 am, 8.30-10.0 am, on 6015 kc, and 8.30-10.0 am on 7200 kc. Here in New Zealand the broadcast band frequency has been heard at good strength at dawn, and the short-wave frequency is good at 6.0 am when an English session is broadcast.

The station first operated on 6040 kc but moved to 6015 kc recently. Programs are in nine Iron Curtain and Near East languages. The transmitters are 150,000 watts on broadcast, and two 35,000 watt short-wave transmitters.

Before the Courier, whose dramatic mission of relaying news of the free world to the peoples behind the Iron Curtain has caught the imagination of the world, anchored at Rhodes, she made a series of 'goodwill" visits to Tangier, Gibraltar, Naples and Piraeus. Readers will remember that the Courier also conducted a test transmission period in the Caribbean area, when reception of the broadcasts was heard throughout the world.

The Courier, as can be expected, has many "hams" in its personnel, and these men will broadcast details on the activity of the ship, and their own amateur experiences on the first Coast Guard cutter ever to have permitted amateurs to operate on board.

The Voice of America's special "Radio Amateur Program" broadcast to hams in over 100 countries, will carry this special broadcast at 9.45 pm on Sunday, November 2, and at 8.45 pm on Monday, November 3, on VOA transmissions to the Far East. The session on Sunday, November 9, will include details on the activity of the amateurs attached to the VOA relay station at Salonika, Greece.

GERMAN STATIONS

This month we devote some space to news of broadcasts in the German language which can be received in Australia.

MANY short-wave transmitters operate in the four zones of Germany, and as well at times, the weaker Austrian transmitters are also heard as well as Berne, Switzerland, which can be received at good strength.

NORDWESTDEUTSCHER RUNDFUNK, Hamburg, is one of the most consistent signals. This station operates on 11,795 kc, and opens at 2.0 pm. Reception is best at 5.0 pm, when a news bulletin is presented, news also being carried at 2.0, 3.0, 4.0, and 5.55 pm.

SUDWESTFUNK, Baden Baden, operating on 6320 kc is using a frequency which is clear of the regular 49 metre band stations, and though using only 1000w, can be heard at times when conditions are favorable with news at 5.0 pm.

RIAS (Radio in American Sector), Berlin, on 6005 kc, provides a good signal in the evenings, and this station operates 24 hours a day. Stuttgart (6030), Munich (6160), and Frankfurt (6190) can also be heard at the same time. In the Russian Section, Leipzig on 9730 kc is consistent in the late afternoons, while when conditions are good the Berlin stations on 6115 and 7150 kc can be logged with news at 4.0, 5.0, and 7.0 pm

Switzerland, in the European service, has news in German at 4.0 pm on 6165 and 9535 kc. London in the BBC's European service has many German broadcasts, the most favorable time for reception is at 4.0 pm (49, 41, 31 metre bands), 7.0-7.15 am (49, 41, 31 metre bands).

Broadcasts from New York on The Voice of America include news bulletins at 6.15, 7.45 and 8.15 am in the 19, 25, 31, 41 or 49 metre bands

KOREA HAS 15-STATION NETWORK

DETAILS on the Korean Broadcasting System, operated by the Radio Bureau of the Office of Public Information, Pusan, Korea, have supplied to us interesting information on the 15 stations they operate. Together with the verification letter, and list of network stations, came a fine hand-painted picture, an appreciation from the chief engineer, Mr. Hahn Ki Syun.

The KBS has established a network in war-torn Korea under severe difficulties described by the engineer as "Fighting the peace in Korea, is fight for desperately on broadcasting wave, with other nations, for the protection of freedom!"

A new short-wave transmitter, located in Seoul, and using 10,000 watts will take the air shortly. At present the two short-wave transmitters are located at Pusan, but take network programs from HLKA, Seoul. These are the only short-wave transmitters operated by the KBS. The Seoul and Taejon medium-wave transmitters on 880 and 970 kc will also increase to 10,000w.

The network uses a common broadcasting schedule, 7.0-9.30 am, noon-3.0 pm, 6.0 pm-1.30 am. Voice of America broadcasts in Korean are relayed at 8.30 am and 9.30 pm. We list below the complete network of both short-wave and broadcast band transmitters operated by the Korean Broadcasting System, as such news we know will be welcomed by readers, as any information in the past on the radio activity in South Korea has indeed been very meagre.

Call	Station	Power watts	Frequency kc
HLKA,	Radio Seoul	5,000	970
HLKB,	Radio Pusan	1,000	2510
HLKB,	Radio Pusan	1000	7935
HLKB,	Radio Pusan	5,000	800
HLKF,	Radio Iri	500	570
HLKH,	Radio Kwangju	500	780
HLKG,	Radio Taegu	10,000	710
HLKI,	Radio Taejon	500	880
HLKM,	Radio Chunchon	300	1230
HLKN,	Radio Mokpo	500	650
HLKO,	Radio Masan	50	600
HLKQ,	Radio Chungju	500	600
HLKR,	Radio Kangneung	500	650
HLKS,	Radio Cheju	500	1080
HLKL,	Radio Namwon	500	1030

NEWS of dx items heard by readers would be appreciated. Send your comments to Arthur Cushen, 212 Earn St., Invercargill, New Zealand. Closing date for next issue is November 12.

ARGENTINA: A new schedule has been noted since early October when the SIRA broadcasts in Spanish have been logged on both LRS 11,880 kc, and LRA 9690 kc, both of which operate to 4.0 pm They carry the same program. Formerly LRA (9690) closed at 3.0 pm following an English broadcast. Another change noted is that LRY "Radio Belgrano" in Buenos Aires, carries its own commercial programs on a new frequency of 9760 kc to sign off at 3.0 pm.

NEW CALL SIGNS, ALLOCATIONS FOR BBC

BBC CALLSIGNS & FREQUENCIES

Metre Band	Call Sign	Kcs.
	GRC	2880
49	GRB	6010
	GWS	6035
	GSY	6040
	GSA	6050
	GSX	6060
	GRR	6070
	GWM	6090
	GSL	6110
	GWA	6125
	GRW	6150
	GWK	6165
	GSZ	6170
	GRO	6180
	GRN	6195
41	GRS	7075
	GRM	7120
	MCM	7135
	GRT	7150
	GRK	7185
	GWZ	7200
	GRU	9915
25	GRG	11680
	GVW	11700
	GVV	11730
	GSD	11750
	GVU	11770
	GWV	11790
	GWH	11800
	GSN	11820
	GWQ	11840
	GSE	11860
	GRE	11880
	GWW	11890
	MCO	11910
	GVX	11930
	MCQ	11945
	GVY	11955
	GRV	12040
	GRF	12095
19	GWC	15070
	GWG	15110
	GSF	15140

NEW ALLOCATIONS

Metre Band	Call Sign	Kcs
41	GWL	7210
	GSW	7230
	GWI	7250
	GSU	7260
	GWN	7280
	GRJ	7320
31	GRI	9410
	GSB	9510
	GWJ	9525
	GWB	9550
	GWX	9570
	GSC	9580
	GRY	9600
	GWO	9625
	GVZ	9640
	GWP	9660
	GWT	9675
	GRX	9690
	GWY	9700
	MCN	9770
	GRH	9825
	GSO	15180
	GWU	15210
	GWD	15230
	GSI	15260
	GWR	15300
	GSP	15310
	GWE	15435
	GRD	15450
16	GVP	17700
	GRA	17715
	GVQ	17730
	GSG	17790
	GSV	17810
	GRQ	18025
	GVO	18080
	GRP	18130
13	GSH	21470
	GSJ	21530
	GST	21550
	GRZ	21640
	GVR	21675
	GVS	21710
13	GVT	21750
11	GSQ	25750
	GSK	26100
	GSR	26400
	GSS	26550

FLASHES FROM EVERYWHERE

CHINA: Radio Peiping broadcasts in English have been revised as far as the frequencies are concerned, and a new frequency, 7500 kc added to the English broadcasts. The present schedule is: 8.30 am on 6100, 7500, 9040, 10,260, 11,690, 15,060, 15,170 kc; 7.0 pm 10,260, 11,690, 15,060 kckc; 11.30 pm, 11,690, 15,060 kc.

ECUADOR: HCJB, Quito ,the well-known missionary radio station, has moved into the recognised 49 metre band, and can be heard at 3.0 pm on 6048 kc, though reception is only poor, due to the severe interference from nearby European transmitters HCJB formerly operated on 5995 kc.

INDONESIA: Listeners who listen to the 60 metre band, will find some strong signals at midnight, from stations in this area. All are on local Dutch or Indonesian programs, except YDB2, 4910 kc, which carries an English transmission 12.30-1.30 am.

THE HAM BANDS WITH BILL MOORE

UHF operators are gradually extending the range of their transmissions by improved technique and shortly most sections of the country will be linked by UHF relays. Field days such as the one recently organised in NSW will do much to promote interest on these bands.

THE State-wide 144 Mc field day, held in NSW over the first weekend in October, was very successful despite very unfavorable weather conditions. It was organised as a joint effort by the NSW, UHF section of the WIA and the Gladesville Radio Club.

Weather conditions were so bad, had stations been forewarned, it is doubtful whether they would have ventured into the field. Portable operation from tents produces enough problems without rain.

The event provided an opportunity for stations over a radius of 150 miles to make contact on the 144 Mc band, and gave many western NSW stations their first contact over any considerable distance.

Propagation conditions were not good, but many excellent contacts were made. The most important single event of the day was the reception of Hugo Stitt, VK2WH, of Forbes by Allan Rodgers, VK3UI, at Mt. Major, over a distance of 250 miles. It appears that shortly we here in Australia will be repeating the contacts of overseas stations over distances of hundreds of miles under suitable conditions.

MOST REMOTE QTH

The portable station operating farthest afield was 140 miles west of Sydney at Mt. Canoblas, near Orange. John Miller, VK2ANF, chairman of the UHF section, was the operator, and assisting him were VK2AMV, VK2ACH and Es Griffiths. They contacted 15 stations; these ranged from VK2ACT, 80 miles to the north, VK2PN, 160 miles south, and back 140 miles to VK2WJ and VK2AJZ in Sydney. Other stations contacted were VK2LZ Wentworth Falls VK2NS Bathurst, VK2JW Orange, VK2WH Forbes, VK2TA Young, VK2HL Mt. Lambie, VK2EI Parkes. All stations on the western plains and slopes were received at good strength.

The equipment in use comprised an 832 final, 6C4's class B modulators, an xtal locked converter, the antenna a three over three beam. Power was obtained from a 240-volt AC generating set.

Horry Lapthorne, VK2HL, with VK2ABZ, VK2NP, Cess Cronin and Graham Allan were located at Mt. Lambie in the Blue Mountains. They suffered most from the weather and had to vacate, leaving their tent there. They found, too, that propagation conditions were much poorer than on previous visits. They contacted VK2ADT Cessnock, VK2NS, VK2JW, VK2WH, VK2ANF and VK2JW, besides some Sydney stations.

FROM CANBERRA

Keith Alcock, VK2AOA, journeyed to Red Hill, Canberra, and was received at good strength at Forbes and Mt. Canoblas, and other stations, but unfortunately, due to receiver trouble, was only able to work stations in the ACT.

Other stations in the field in the Blue Mountains were: Allan Tolloy, VK2AST, at Mt. Tomah, and Warren Lamb, VK2AGL, Mt. York.

All stations west of the mountains were active, while 26 stations in Sydney cooperated. The prize and trophy winners have not yet been decided. Prizes are: A prize of £5/5/- donated by Horry Lapthorne, VK2HL, and will be divided between the stations making contact over the longest distance, one to be a field station. A cup presented by the WIA UHF section will be given to the field station making the greatest number of contacts. £2/2/- donated by the Gladesville Radio Club for the station outside 50 miles of Sydney making largest number of contacts. £2/2/- donated by the WIA for the station within 60 miles with the greatest number of contacts.

The Hunter branch field day, held at Lake Macquarie, was well attended by nearly 40 amateurs and their families. The rather novel approach to several of the competitions created considerable interest. The normal Morse code recording, plus all the horrible types of QRM, was played, and amateurs did their best with its reception. At the completion of the test it was announced, much to the consternation of the competitors, that the contest was a tone frequency guessing one. Please supply the frequency of the tone used. A CW prize was awarded, too, to offset the shock to the contestants.

The 144 Mc transmitter search was divided into two heats—the idea a good one, too—gave all present an opportunity to participate. This was achieved by loaning equipment to parties not equipped and the same gear was used in both heats.

Special attention was paid to the requirements of the XYL's and kiddies and competitions arranged.

President Lionel Swain, VK2CS, presented prizes to the various competition winners.

144 Mc Transmitter Search.—1st Heat: 1st, VK2EO, VK2FP and party, time 5 minutes; 2nd, VK2VU, VK2ADT and party.

2nd Heat: 1st, VK2DG and party; 2nd, Radio Inspector Frank Hincks and party; 3rd, VK2NX and party.

Tone Frequency, 1620 cycles: 1st, VK2KG, 1600 cycles; 2nd, VK2AGD, 1650 cycles.

Morse Test: 1st, VK2EO.

State secretary Dave Duff, VK2EO, and QSL officer Jim Corbin, VK2YC, represented the NSW division at the field day. Many amateurs assisted to make the day a success, including branch secretary Varley Fitton, VK2SF, VK2AHA, VK2ANA, VK2DZ, VK2AXM, VK2KG, VK2XY, VK2XT, VK2FX, Dave Ellsey, Bert Harvey, John Cowan.

WOY WOY FIELD DAY

The full program for the NSW division's annual Woy Woy field day has been arranged and all attending including the XYL's and kiddies will be well catered for.

The date is Sunday, November 16, and the usual assembly point, the Masonic Hall, Woy Woy, will see the officials ready to receive visitors at 11 am.

Competitions will be run during the morning sessions while the 144 Mc hidden transmitter search will be conducted in the afternoon.

Prior booking is not necessary, just come along, light refreshments will be available and ice-cream and soft drinks will be free for the kiddies. You are assured of a good day's entertainment and an opportunity of meeting amateurs from many parts of NSW. Keep the date free.

CONTEST NOTES, CARDS AND AWARDS

The first week of the 1952 VK/ZL DX contest devoted to CW, provided some good openings, especially to Europe on 14 Mc. Propagation conditions generally were a great improvement over recent weeks and all continents appeared at various stages.

21 Mc opened to North America for most of Sunday morning and to Europe late in the evening.

80 metres was surprisingly good to W, VE, in the early evening—few stations from North America have been heard there for weeks, but the contest managed to attract a good number of Yanks from their beds.

Increased activity generally showed the bands were not in as bad shape as we imagined.

Logs from VK and ZL stations should be posted to the NZART Contest Manager, 86 Lytton Rd., Gisborne, NZ, to arrive not later than December 31, 1952.

For the first time on record major national societies are not in agreement on the status of a series of countries for certificate qualification purposes. The area in question is the Falkland Islands and portions of Antarctica.

The ARRL for some years now, have been refusing to recognise for DXCC purposes, cards from the area from LU (Argentine) and CE7 (Chilean) amateur stations operating there. Cards were accepted from British stations in the Falkland Islands (VP8), and other official expeditions in Antarctica (KC4, FB8, &c.).

The territorial position in Antarctica due south from South America is quite confused. The original British claim is now over-lapped by both Chilean and Argentine claims, while the latter two claims overlap, too

The ARRL after a series of inquiries, approached the US Government, and it was found that their Government did not recognise any claims of individual countries to the Falkland Islands or any portion of Antarctica.

In view of that information, cards from LU and CE7 amateurs in the area will be accepted for DXCC purposes.

The RSGB however, will not recognise such cards, as they point out HM Queen Elizabeth II claims sovereign rights over the Falkland Islands and Dependencies and in their view these stations have no legal status.

The Sixth All European DX contest will this year be conducted by the Danish National Society, the Experimenterende Danske Radio Amaterer. The organisation of the contest is rotated annually between the various European National Societies.

The Danish Society runs this year's contest to commemorate the 25th year of its foundation.

The contest periods are as follow:—CW Section commences December 6, 1952, at 0001 GMT and concludes at 2400 GMT, December 7.

Telephony Section commences December 13, 1952, at 0001 GMT and concludes at 2400 GMT, December 14.

Amateurs in Europe will be endeavoring to conduct as many stations as they can outside the continent, they will call CQ AW (CQ all the world). Stations outside Europe will call CQ EU (CQ Europe).

Full contest information will be supplied in Amateur Radio and other national magazines.

W.A.E. AWARD

NEW rules are to hand for the Worked All Europe Award (WAE) sponsored by the DARC (German National Society).

The award is available to amateurs all over the world, and is limited to contacts made since June 1, 1946, on recognised amateur bands.

The countries list comprises 60 different European countries, and is based on the official ARRL DXCC list.

To qualify for the award, entrants must produce evidence of having amassed 100 points by working 40 different countries in Europe. One point is awarded for each contact with a different country on each of the following bands, 1.7, 3.5, 7, 14, 21, and 28 Mc and two points for contacts on 50, 58, 72 and 144 Mc.

The award would be a difficult one for VK stations to win.

GRAND COMPETITION

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Aircraft turn & bank indicator containing mechanical gyro and ball type level—17/6

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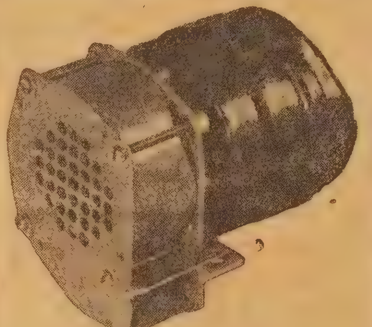
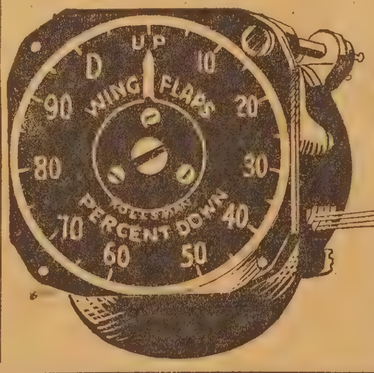


Aircraft air speed indicator—20/-

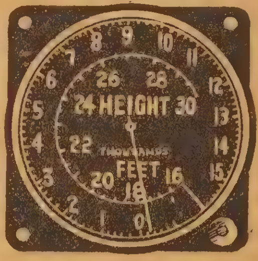
Aircraft climb and descent meter—17/6

CLIMB
THOUSANDS
FEET/MIN
DESCENT

Aircraft wing flap indicator—17/6



Aircraft height indicator—25/-



TO EACH OF THE ABOVE PRICES ADD PACKING AND POSTAGE AS FOLLOWS:—
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The winner's name will be announced in the February issue of Radio & Hobbies. Address all entries to Box 5234, G.P.O., Melbourne.

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NEWS FROM WIRELESS INSTITUTE

ANGUS ROBERTSON, VK2IQ, journeyed from Sydney to lecture at the September meeting of the Hunter branch of the WIA. The venue was the 2HR Auditorium, Maitland, where meetings are held periodically to allow amateurs from outlying towns in the valley to meet the members of the branch.

Angus took as his subject Loudspeakers, and presented as usual a very instructive lecture and the gang appreciated more fully the works after the output transformer when he had concluded. His views on manufacture were also very illuminating.

Over 100 members attended the September meeting of the NSW division when Mr. Reg Rawlings, of Philips Electrical Industries of Aust., lectured on Test Equipment.

On display was an extensive array of measuring apparatus of all types, and Mr. Rawlings described fully the uses and design of this equipment. He explained how modern circuits demanded more advanced equipment for measuring purposes—apparatus that reflected less on the source to be checked. At the conclusion of the lecture general discussion brought out many interesting points.

During general business Federal councillor, Vaughan Wilson, VK2VW, gave notice of motion of his intention to move at the October meeting that it be suggested that a Federal convention be held in Melbourne next year. At the Federal convention held this year in Sydney it was decided that conventions be held biannually and next one is scheduled for Melbourne in 1954. If the motion is passed Federal executive will be requested to obtain views of the other divisions on the subject.

The recent decision of the Federal executive of the WIA to press for a change in the Federal Constitution to withdraw the executive's voting power at Federal conventions, will bring this section back into line with procedure prewar.

It means that State divisions only will vote on the various items brought forward at Federal conventions. The action of the executive in this matter is to be commended.

In effect, the accepted WIA policy of true democratic representation for members, will again come into force. The Federal president will be in a position to preside at conventions as a disinterested chairman, with a casting vote to break any deadlocks. Members of the executive would be ex-officio members of the Federal council.

The action of the Federal executive too, in obtaining from the PMG's Department special facilities for emergency operation on the 160 metre band, is a valuable forward step.

These frequencies should prove very useful during most of the year, and will allow emergency nets to organise with the knowledge that they have a separate set of frequencies less likely to suffer from interference.

The frequencies 1840, 1860 kc are available, and telephony or CW can be used with inputs up to the normal 100 watts.

DX and PERSONAL

THE Romford RSGB group ran in August a nocturnal DF hunt, a change from the normal run of hidden transmitter searches. If the idea is carried out here, it would provide more interesting competition, as the time taken to find transmitters during daylight hours is so short—generally a matter of minutes. If run strictly on the Romford lines, perhaps the XYL's would raise some objection—the search commenced at midnight, breakfast was served at the completion and prizes presented.

The 21 Mc band has provided some fair openings to Europe around 2300 EAST. 14 Mc seems to be suffering from lack of occupants. On a number of evenings the band was wide open but few stations appeared. Many stations who operated consistently on the band have moved to the lower frequencies, and without a doubt until there is an influx of stations, any true check of whether conditions are improving will be difficult to make.

Vic ZC5VR, at Sandakan, Borneo, has been active on 14,190. Whether the prefix is legitimate is unknown, it would normally be VS4, although it is stated the call was issued in Singapore.

Best DX heard during the month was ZD7A, St. Helena, was first operating on 14,080 kc at 0630 hours EAST.

Subsequently was heard dodging about to miss the hordes of W stations operating on and around his frequency. His efforts were fairly successful, as at one stage stations calling him were spread over about 60 kc.

Conditions were so improved on 14 Mc that within 30 minutes 0630, 0700 hours FA8CR, HZ1AB, ZB1GKU, LU8EO, and W3BES were heard for a WAC.

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OFF THE RECORD — NEWS & REVIEWS

My comments this month are rather varied. They concern the release of records by the Sydney Symphony Orchestra, some details of new LP records released in England, and a couple of book reviews.

By *JOHN MOYLE*

WE have now had sufficient time to assess the first of the Sydney Symphony Orchestra's new records which were made by EMI in Sydney last April. Three works have so far been released, and the others will no doubt follow in due course.

The three so far issued are the Symphony No. 1 by Beethoven, Danse Macabre by Saint-Saens, and Sinfonia Savillana by Turina. One a well-known classic, one a classical well-known, and one a new work which it is reported has not previously been recorded.

Having been given the opportunity to hear some of these during the actual recording, I have been eagerly looking-forward to hear how they compared with the performances as I originally heard it from the tape.

From a technical viewpoint, one can dismiss right away any ideas that the discs call for any allowances.

In the case of nearly every Australian-made disc of comparable type I have heard, there has been a tendency, consciously or otherwise, to comment — "jolly good for a local effort." But these records, both technically and musically, bear all the marks of really good recording. Here and there the standard is very nearly the best, and that isn't by any means faint praise.

Like everyone else, I was first of all interested to assess the orchestral standard against the general background of recordings. Most of us have heard our orchestra many times over the air playing all kinds of music, but it is something of a shock to hear the vastly improved type of sound which comes through the loudspeaker from these records.

We wouldn't expect it otherwise, but as we can't physically bring half-a-dozen world famous orchestras to Sydney for a comparison, we have to achieve the process from discs.

And I don't think there are very many combinations which can put our players to shame. I did think there were signs of meticulous care in all three, which may have taken a little edge off here and there. Danse Macabre didn't rattle the bones quite as devilishly as it might have done — an approach being more gentlemanly than otherwise. The Beethoven I thought could have been improved by a little tighter tempo, although this symphony doesn't provide as much scope as some others for what I might term striking work.

The Turina, on the other hand, I thought very hard to fault. All the records are remarkably good in the matter of orchestral balance, but this one is particularly so. It brought spontaneous expressions of admiration for the clear-cut recordings of the various sections — the brass, for instance and the solo violin, and the beautifully-played theme from the cor anglais. This is really impeccable playing—the kind of thing Goosens and the orchestra always do well.

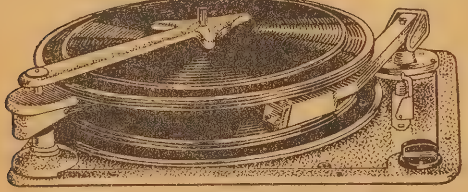
This work places quite a responsibility on the orchestral groups, and I think you will be struck by the way they respond.

TECHNICAL ASPECT

Reverting to more technical matters, each of these discs played cleanly without exception right to the end. True there are no heavy passages to be fitted into the last few grooves, but the fact is that there is virtually no increase in distortion or degradation of tone from start to finish in any of them. For this we can be grateful to the technical care of those who made them.

The frequency response, too, is very good. Again the Turina is perhaps the best example of this, as it probably covers the widest range in instruments and general dynamics. There is some really good bass recording, and the top end is limited only by the surface noise. This, however, isn't abnormally high. We must blame microgrooves for resenting its intrusion at all.

There is little doubt that the experiment, if we can so call it, has been completely successful. I sincerely hope the records will now achieve the sale they deserve, and thus lead to more in the future. As the orchestra gains more experience in recordings, it will certainly improve its standard still further, and can, I am quite satisfied, produce records which will stand with the



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best made anywhere. I for one am most anxious to hear the remainder of the series.

In summary, I would place the all round rating as high. The best work he Turina, and the best side EDI2II.

I have received a list of the microgroove records issues by EMI in England. It occupies three type-written pages and a wide variety of classical and semi-classical music. In HMV 33 LP's there are 22 works. The ALP 12in Red labels sell at 39/6, BLP 10in Reds at 29/6, CLP 12in Plums at 35/-, and DLP 10in Plums at 26/6.

Columbia LP records include 15 works. Prices are the same as HMV but bear the prefixes 33CX, 33C, 33SX, and 33S. They include the Lipatti - Karajan recording of the Schumann concerto which I mentioned recently as being a work which could well be re-issued on LP, the Beethoven Fifth Concerto by Gieseking, Debussy's Nocturnes and others.

Parlophone are represented by four releases, the prefixes being PMA, PMB, PMC, and PMD and the same prices.

NOW ON 45 RPM

Then we have about 40 7in 45 rpm records issued under HMV which, from their content, appear to be direct counterparts of the present 78's. In other words, the present standard vocal and instrumental material found on 78 12in records has been simply re-issued on 45's.

I found it a little puzzling to note that some material has apparently spilled over on more than a single 45. It may indicate that there is still some recordable music which can't be fitted into one side of anything, although that's hard to believe.

The 45 series sells on Red labels for 9/8½ and Plum labels for 6/10.

It is difficult at this stage to estimate when these records will be available here in Australia with the present limits on imports. It seems doubtful whether any of them will be released this year, despite the impression that some were to be ready for the Xmas market. My own reaction to the first list is that it is quite a good one, and contains much standard work which should be readily accepted, provided the production standard is as good as we have reason to believe.

It seems likely that before long other announcements may be made concerning the manufacture and release in Australia of LP records from overseas. Without saying more at present, it looks as though Australia is acquiring the reputation of being a good record market. For my part anything which brings us more and better records looks good.

BOOKS FOR REVIEW

I have a couple of books for review this month.

The first is the "Gramophone Handbook" by Sydney journalist Selwyn Speight.

It is a book written not for the technician, but for the serious record lover who wants to add to his knowledge and background.

There is plenty of material here, ranging from hints on the selecting of a gramophone, simple fault finding, care and maintenance to a simple explanation of the physics of sound There is a lucid account of pick-ups needles, grooves, speeds, and all those things a good record man should know but may not.

There are numerous practical passages, too, such as those dealing with speaker battles and pick-up tracking.

Being a gramophone critic, Mr. Speight is quite free with his expositions of the art of listening, and the interpretation of recorded sound by the music lover. These I think will provoke many a discussion, one of which (and I think I'd be in this) might concern whether or not false sound values and low sound values are really the same thing.

In conclusion there is a large and most painstaking list of records classified according to their technical and musical value as seen by the author. My only regret is that such lists can so rapidly go out of date, although we might hope that this fine little book might be favored with extra editions.

It is published by Currawong Press and sells for 25/-.

ON AMPLIFIERS

The second book comes from London, and is "Amplifiers — The Why and How of Good Reproduction," by G. A. Briggs and H. H. Garner.

It is a companion book to some others by Briggs on Loudspeakers and Sound Reproduction, and is meant for the technical enthusiast who builds his own equipment.

There is really an amazing amount of information packed into these pages, and the coverage of the subject is exceptionally complete.

It commences with valve theory, continues by steps until we emerge with the final amplifier design, deals with tone compensation in general, power supplies, whistle and scratch filters, hum tracing and so on. Virtually every point is illustrated by a diagram, some of these being some fine demonstrations of amplifier characteristics by using a moving film, oscilloscope, and oscillator so as to draw a complete picture of amplifier response over a given bandwidth.

FINER POINTS

The book concludes with many questions and answers, and some suggested circuits by Major Garner for amplifiers, tone control circuits and tuners.

Various technicians have their own ideas on various subjects, and I don't, therefore, wish to be unduly critical when I express lack of complete agreement in one or two of the author's assessments, and indeed his explanations of theoretical points. However, I know only too well the difficulty of complete consistency and even accuracy when writing in more or less popular vein on technical subjects. I couldn't, therefore, put these forward as reasons why the book should not be well received. I liked the practical approach to the subject, the habit of summarising progress at the end of each chapter, and the questions and answers which often make points in a most effective manner. Our copy came from McGill's agency, and the price is 23/9.

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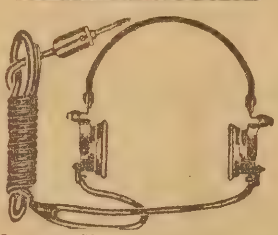

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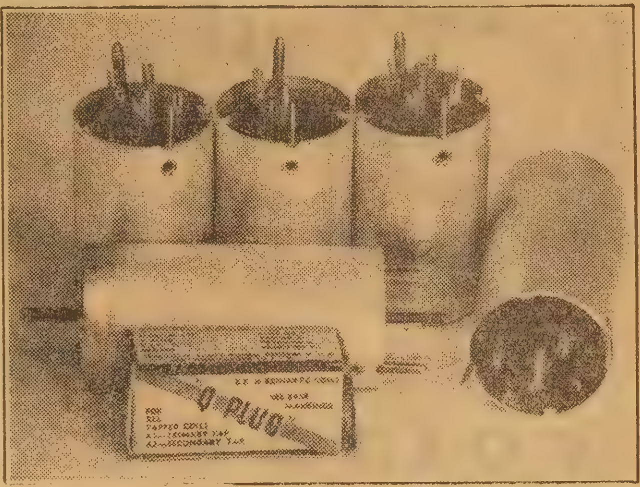
Q-PLUS RELEASE BAND-PASS COIL KIT

R.W. Steane and Co. Pty. Ltd., makers of the well-known Q-Plus brand of coils, announce that they have developed a set of coils to suit the popular Radio and Hobbies' wide-band AM tuner. One or two minor alterations to the original design, intended to provide improved performance and convenience, are worth noting.



THE complete kit consists of two 1900Kc IF transformers, suit-bly coupled to provide the necces-ary 10Kc band width, an oscillator oil to match, and the band-pass erial coil unit consisting of two coils. ll the above are mounted in stand-rd cans, but the whistle filter coil, vailable as a separate item, is ounted on an iron dust bobbin.

One modification is a somewhat ghter coupling of the IF trans-ormers, thus providing a broader esponse in this part of the circuit nd calling for a smaller coupling apacitor in the aerial band-pass cir-uit. This is specified as between two nd three turns only of 7/.010 PVC ook-up wire, which is considerably ess than the original specifications. he makers claim that this approach s some advantages over the original esign.

Another modification is the use of "built-in" padding condenser in he oscillator coil which is so ad-usted that in most cases a 3 to 30 f trimmer is all that is required to rovide exact tracking. The makers recommend that alignment be carried out by the three point tracking process whereby the oscillator circuit is adjusted by means of the padder at the low frequency end, the adjustable iron core in the centre, and the trimmer at the high frequency end of the band.

The kit has been marketed without a whistle filter coil for the convenience of those who may have already bought this component for use in earlier TRF circuits.

It is available as an extra item for those who require it.

Further details about the above coils may be obtained from R. W. Steane and Co. Pty. Ltd., Eastern Place, Auburn, Victoria, or their agent in NSW, Mr. J. Hibbert, 277 Clarence St., Sydney.

KINGSLEY DUAL-WAVE UNIT KU4

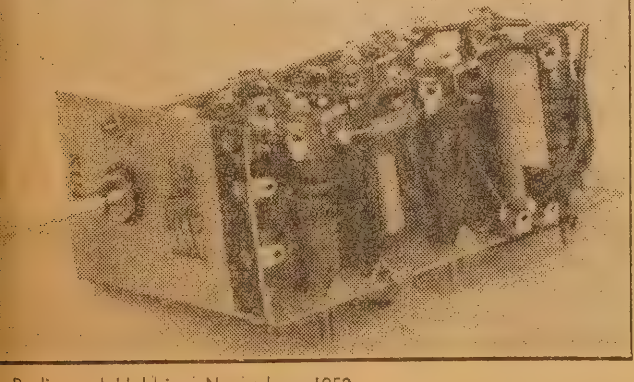
Kingsley Radio have recently released a dual-wave bracket, incorporting an RF stage, which is intended for use in high performance domestic receivers.

THIS unit, known as the KU4 series, is available in a number of ver-ions to suit a wide range of con-erter valves, both battery and AC, he one illustrated being the KU45, ntended for use with the ECH33, K61M, or 6K8G valves.

The frequency coverage is from 40 to 1650 Kc on the broadcast and and from 5.9 to 18.2 Mc on the hort-wave band. An important point about the latter coverage is that it includes the 6 Mc band used by the ABC to provide service to areas not served by the normal broadcast channels.

The unit appears to be a particularly well made one and gives the impression of having been extremely well engineered. AVC by-passes and decoupling resistor are included, the trimmers are of good quality concentric type, and iron cores are fitted with tension springs, which effectively earth them as well as providing tension to prevent drift.

Further details may be obtained from the makers, Kingsley Radio, 3 Cornel Place, Carlton, Victoria, or their agents.



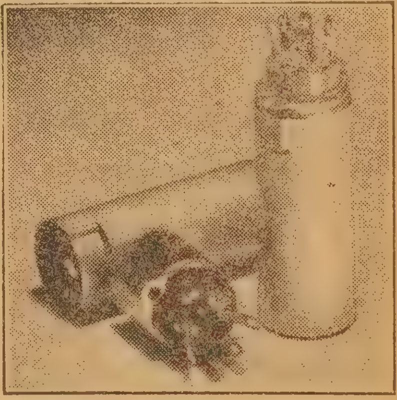
TELETRON MINIATURE 7-PIN SOCKETS

W. J. McLELLAN, agents for the well-knokn brand of Teletron components, announce that they are ow able to supply miniature seven pin sockets in this brand.

Four types are available and are intended to cover most constructional requirements. These carry the following type numbers: FT47G, FT57G, ST47L, and ST57L.

The FT series are made from high grade, black moulded bakelite and have electrical characteristics suitable for most ordinary applications. The type 47G is supplied with skirt only, and the type 57G with skirt and shield.

The ST series are moulded from mica filled natural powder and are intended for use in applications, such as UHF receivers, where it is important that losses be kept to a minimum. This type is easily recognised by the straw colored moulding material. The type 47L is fitted with skirt only and the type 57L with skirt and shield.



The shields are fitted with a tinned steel wire spring to retain both the valve and shield in place.

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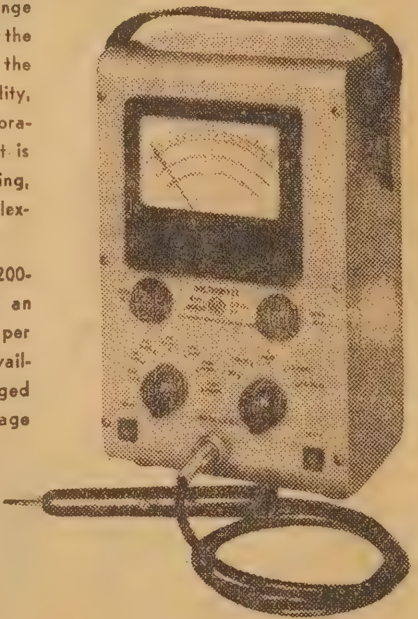
The Voltohmyst uses a rugged 200-microampere movement with an accuracy of plus-minus 2 per per cent; standard probes are available and can be interchanged quickly for different types of voltage measurement.



NOTE THESE POINTS

- Directly measures complex waves from 0.2 to 1400 volts, peak-to-peak.
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MORE ABOUT THE ELECTRO-FLASH

(Continued from Page 87)

dition, whereby it was possible to fire the flash by dropping a small sheet of paper on to the cotton.

This makes possible some very interesting pictures, such as a box of matches or a packet of drawing pins in the process of being spilt.

Another method of synchronising the flash with the required action is to pick up the sound of the action with a microphone, amplify it, and feed the output of the amplifier into a sensitive relay which closes the flash circuit. A variation of this is to use a thyratron valve in place of the relay to eliminate any time delay which the latter might introduce.

While such schemes are not necessarily beyond the scope of the advanced amateur, it is not likely that the work involved would be justified unless there was a special reason for wishing to investigate a particular phenomena.

However, it is used extensively by scientific research organisations and makes possible pictures of sporting equipment in action and other similar shots, where it is not possible to make direct electrical contact. Delay in firing the flash, which is often desirable, can be achieved either by means of electrical delay circuits in the amplifier, or by increasing the distance between the source of sound and the microphone.

OTHER SCHEMES

There are many variations of the mechanical firing system, such as placing sensitive contacts under a board on which objects can be dropped or directly behind objects to be struck. Again, there are many effects which do not need to be accurately synchronised in order to produce an interesting picture, either because they are continuous in their action, or because the total time of the action is long enough to enable a picture of some part of it to be obtained by visual firing.

Another feature of the high speed of the flash is that camera shake is virtually eliminated. So obvious is this effect that many workers, even professionals, have expressed the opinion that the light possesses some rather vague and magical quality which permits far better rendering of fine detail.

This feature is an extremely valuable one, particularly when pictures have to be taken under difficult conditions, when the subject may not be co-operative and it is impossible to hold the camera completely steady.

And finally a word about the firing circuit. If there is a tendency to misfire it might be advisable to increase the 2 meg. resistor in the firing circuit to 3 meg. The value of 2 meg. is quite satisfactory, providing the 10 meg. resistors forming the main part of the network remain reasonably accurate, but these have a tendency to increase their resistance to the point where the voltage in the firing circuit is seriously reduced. The 3 meg. value will overcome this without upsetting the circuit if the 10 meg. resistors remain normal.

COURSE IN ELEVISION

(Continued from Page 73)

By the use of high-speed process- chemicals and high temperatures is possible to develop, fix and dry film suitable for projection in s than one minute, a figure of 56 conds being frequently quoted. is in itself is a rather remarkable hievement, as anyone who has ever bbled in a darkroom will realise.

Since the presentation of the image s been delayed it is also necessary delay the sound by an equivalent ne. There appear to be two ap- oaches to this problem at the pres- t time. One is to record the sound the same film as the image, fol- wing more or less standard sound film techniques, and the other is record on a separate tape.

While the film recording would iminate any problems of synchro- sing the sound and movement, it pears to suffer from poor quality, fact which is not surprising when is realised how carefully sound lms have to be processed in the rmal way in order to keep dis- rtion to a reasonable minimum.

It would seem that the obvious an- ver will be a magnetically recorded und track on the edge of the film -an idea that is being used nowa- ays in 16mm home movies.

It is fairly obvious, however, that e cost of operating an intermedi- e film system must be very high d that it would be only suitable r special applications. Thus, here a special event was to be rtrayed at two or three large eatres only, and the organisation ncerned had exclusive television ghts, it could be quite satisfactory ecause not only would there be an ssured box office, but also a market r the finished films, which could e released almost immediately for reening in other theatres.

On the other hand, ordinary pro- ram material, such as regular films, ould not benefit by the rapid dis- ibution feature unless costs could e kept low and the intermediate lm system would seem to be quite nsuited to work of this kind. This the more so since there would e no market for the intermediate lm once it had been screened.

(To be continued next month)

CRYSTAL PICKUPS

(Continued from Page 81)

ass response will thus counter the ecording loss, though the natural ise around 400 cps, referred to ealier, nds to reappear. However, the gen- ral configuration of the curves is rawn to a very open db scale.

A load of 0.1 meg is fairly close to ptimum for microgroove, while .05 eg is nearer the mark for 78 rpm ecords. Since different values of ompensation are required, it is im- ossible to select one figure which ill be optimum for both.

You can elect to use either value ingly or adopt a compromise figure f say 70,000 ohms.

De-emphasis for microgroove can e effected by means of the normal one control.

BUILD YOUR OWN CABINET

(Continued from Page 37)

it is possible to obtain a smooth, hard finish, which gives no clue to the fact that the cabinet is made of wood. This involves two and possibly three coats of undercoat or brushing surfacer.

After the first coat, rub it down all over with sandpaper. When the job is ready for the second coat there will be a good deal of wood showing. The idea is that the undercoat which remains will fill up any small indentations in the surface. If you have done a good job with the plastic wood you may be able to get a perfectly smooth, even surface with only two undercoats.

SANDING

Before applying the color, give the job a rub over with sandpaper to remove brushmarks and dust specks. The sandpaper must be very fine to avoid leaving scratch marks and probably the best approach is to use some of the partly worn-out pieces from rubbing down the previous undercoat.

Choose a good quality enamel for the finishing coats. It may be possible to obtain the desired finish with one coat, but if you make it sufficiently thick to cover the surface adequately you entail the risk of runs which spoil the appearance of the work. If you give the job two coats, you avoid the risk of runs and any dust specks which appear in the first coat can be removed easily.

For the final coat, choose a dust free location, make sure that the brush is thoroughly clean and stir the paint properly. A brush about ½in wide is a good choice for a cabinet of this size because it is sufficiently fine to allow access to the edges of the fret, and at the same time is able to cover the flat surfaces reasonably quickly.

The color you choose is a matter for yourself. The tuning and volume control scales on our set are a very light brown, and it seems natural to have the cloth behind the fret of a similar color. You can paint the cabinet a darker brown to tone with the cloth and the scales or, alternatively, you can choose a contrasting color. We like the effect of light green actually Dulux "spotlight" green."

A piece of card is used to support the material behind the fret, and at the same time it serves as a baffle for the speaker. Cut the card to about 7 3-8in by 4 1-8in. A round hole of diameter 3in should be made in the centre of the card to allow for the speaker. The position of the two holes for the control shafts can be marked by using the front of the cabinet as a template.

The fabric should be cut so as to leave a border about ½in wide all around the piece of card. It can then be secured to the card by turning the border over and pasting it down on the rear face. The card with its fabric covering can be secured in the cabinet with some small tacks or a spot of glue in each corner. When the set is in the cabinet the speaker is pressed against it so there is no need to make elaborate fixing arrangements.

SMALL FEET

To complete the cabinet, glue a small piece of rubber or felt under each corner of the base to prevent it scratching polished furniture. The rubber feet usually sold for the purpose may be thicker than is required.

The finished cabinet is very attractive indeed, and would not disgrace any homebuilder. And, just as important these days, it costs only a fraction of an equivalent commercial job.

MOVIE SYSTEM GIVES ADDED REALISM

(Continued from Page 23)

proved difficult and was finally overcome by making the edge of the film gate irregular rather than straight and also arranging for these irregular edges to move up and down at high speed, thus removing any clearly defined edge and allowing one picture to merge into the other.

Yet another problem was that of keeping the three projectors exactly in synchronism and this was only solved by providing a central control booth, equipped with indicators and control equipment, from which a control engineer supervises and controls the speed of all three projectors.

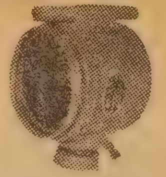
In spite of all these problems and the increased bulk and running cost of the equipment, the company maintains that it does a better job in much less time than is possible with conventional equipment, since it is not necessary to cover the scene from a variety of angles in order to show all the action. Thus they claim that a scene which would take weeks to cover in the normal way can be completed with the new equipment in a few days.

Temperature-Indicating Paper

A COATING that can be designed to melt at any given temperature has been developed, according to an American publication. The white pigment coating on black paper melts into the paper base when its specified melting point is reached, leaving a black background. Instant temperature readings between 115 and 500 degrees are possible.

Temperature indicators based on color changes have been used for some time, but are of no use to color blind persons. This difficulty is avoided in the new black and white indicators. Materials are readily available, and, if the thermometers are put into mass production, the cost should be small.

ENGLISH ARMY SPOTLIGHTS



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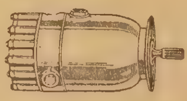
6-volt, 37/6. 12-volt, 25/-. Fitted with Mirror Reflector.

HYDRAULIC PUMPS, EXTRA LARGE

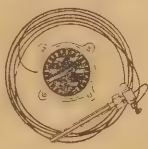


1200lb per sq. in.

8 1/3 gal. per minute

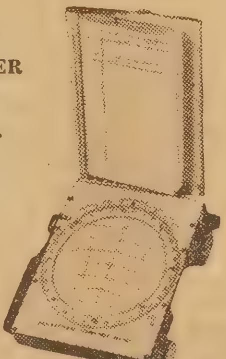
Ideal for all Hydraulic uses. Cost £100. OUR PRICE. £18/18/-.
Also 1½ gals at 1000lb per sq. in. £7/10/-
3 Stage Hydraulic Pumps, 1200lb pressure 5 gals per minute. £10/10/-.

BRAND NEW REMOTE CONTROL TEMPERATURE GAUGES.



37/6

Ideal for cars, tractors, boats, ovens, etc. Never before at this price.



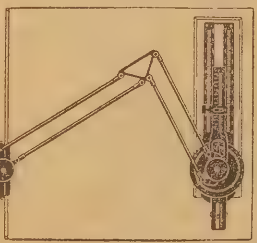
IN FIRST
CLASS ORDER

DALTON
COMPUTORS.
IDEAL FOR
AERO CLUB,
A.T.C., ETC.

Only
Limited
Stocks
Available.
Be early

45/-

R.A.F. PLOTTING BOARD WITH ARM

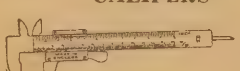


Bakelite
Base.
Draws
Angles
Parallel
or
Vertical.

70/-

IDEAL FOR ENGINEERS. STUDENTS, ETC.

BRAND NEW VERNIER CALIPERS

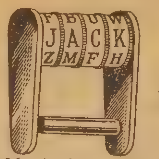


22/6

Will measure inside and outside. Can also be used as Depth Gauge. Ideal for all types of engineering work. Measures in inches and m/m

NOVELTY COMBINATION PADLOCKS

No Key Required



5/-
each.

Ideal for push-bikes, lockers, trunks, etc. Many combinations available.

BRAND NEW AMERICAN THROAT MICROPHONES

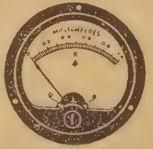
IDEAL FOR
FITTING TO
GUITARS,
VIOLINS,
& SIMILAR
MUSICAL
INSTRUMENTS

Lots of Fun!

AS
USED
BY THE
R.A.F.

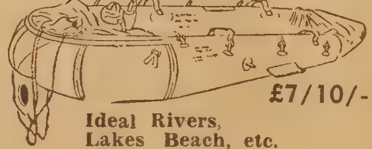
10/6

SPECIAL DISPOSALS METER OFFER.



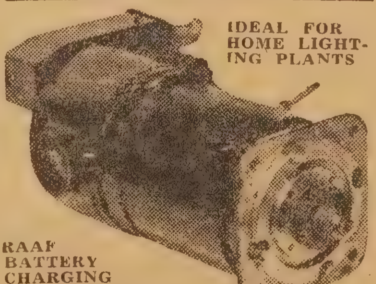
0-1 milliamp, 2½in dial	37/6
American Weston 0-50 voltmeters, Moving Coil	42/-
Weston 0-50 volt 0-100 amps combined M/coil	£3/10/-
English 50-0-50 Ammeters M/coil	32/6
English 20-0-20 Ammeters M/coil	32/6
English 0-20 Voltmeters M/coil	25/-
English 0-300 AC-DC Voltmeters	55/-
English 0-5 Milliammeters, 2¼in	27/6
English 0-150 Milliammeters, 2¼in	30/-
English 0-10 Ammeters, 2¼in Dial Moving Coil	45/-
English 0-5 Milliameters Centre Zero Scale, 3in Dial	42/-
English 0-30 Voltmeters, 2½in Dial AC-DC.	42/-
Eng. 0-40 Ammeters, 2¼ Dial AC-DC	42/-
English 0-50 Ammeters AC-DC	42/-
Eng. 0-3 Ammeters 2¼in Dial AC-DC	45/-
Eng. 0-5 Ammeters 2¼in Dial AC-DC	45/-
Eng. 0-150 Voltmeter 3in Dial. Moving Coil	39/6
Eng. 0-500 Micro Ammeter M/coil	37/6
Eng. 0-150 Ammeters 3½ in Dial AC-DC	84/-
Eng. 0-50 volts 3½in Dial AC-DC	75/-

R.A.A.F. RUBBER DINGHIES



£7/10/-

Ideal Rivers, Lakes Beach, etc. Fitted with standard tyre connection for use with CAR Pump. Invaluable for flooded areas.



IDEAL FOR HOME LIGHTING PLANTS

RAAF BATTERY CHARGING GENERATORS.

12-volt, 500 watt, in Good Working order	£5
12-volt, 500-watt, as new	£10/10/-
24-volt, 1000-watt, Brand New.	£12/10/-

SURPLUS

512 ELIZABETH ST., MELBOURNE, C.1.
PHONE: FJ5904. Just 4 doors fron

Mail Orders Carefully Packec
PLEASE ADD FREIGHT OR POSTAGE

NEW DEPARTMENT SPECIAL

All wool Army blankets	32/6
Heavy duty Army boots	39/6 pr
Officer type boots	52/6 pr
Jungle green herring bone self-supporting trousers	39/- pr
Travelling all wool rugs	55/-

Please quote size of trousers o boots when ordering.

SPECIAL OFFERS

English 230 volt A.C. Relays, 50/- Genuine English R.A.F. Flying Helmets, 35/-. Speaking Tubes to fi helmets, 50/-. R.A.F MK8 Goggles 48/6 pr. English 4 Draw Rifle Range Telescopes. 22 magnificatior 17¼in long when extended. Wonderful value, £6/19/6.

Swiss Music Box Units can be fitted into any type of box. Make yourself a music box. Tunes available; Whistle While You Work; Home Sweet Home; Happy Birthday To You; When Irish Eyes Are Smiling; Forever and Ever 30/-. Medical Scalpels, many uses, photographers etc. 6/6. Twist Drill Sets 1/16in to 3/16in. 9 Drills for 6/9; 1-16in to 7/32in. 7 drills for 6/9. Shaded Pole Induction Motors, made by Hoover of England, 230 volts, A.C. Ideal for projectors, Tape Recorders. Fans, etc., £4/19/6. Ball and Socket inspection Mirrors. Ideal for Mechanics or Radio work. 8/6. Tapped Transformers, 6, 12, 18 and 24 volts. 3 amps. 39/6. 230 volts input.

American Heavy Duty 10in Dividers, 10/6. American Radius Gauges. 9/6. 4in Callipers, inside and outside, 5/6. Full length Men's Oil Skin Coats. Ideal for all outdoor work. 35/-. American Alemite Grease Guns Suit all modern cars, 32/6. Army Camp Stretchers, folding legs canvas top, 55/- English Low Pressure Spray Guns, work off 35lb pressure, £3/15/-.

Imported Stock and Die Sets ¼in ¾in, & 1in water pipe sizes, £5/10/- Sport Binoculars wonderful value, 55/- pair.

BRAND NEW ENGLISH RECTIFIERS

Make yourself a Battery Charger

12v.	2 amp	35/-
6v.	5 amp	45/-
12v	5 amp	72/-
6v.	2 amp	24/6
12v.	3 amp	45/-
6v.	4 amp	39/6

Transformers to suit above Rectifiers, 2 and 3 amp. 37/6. 6 and 12 volt 5 amp, 45/-.

STORES

12 ELIZABETH ST., MELBOURNE, C.1.
toria Street. PHONE: FJ5904

d Efficiently Despatched
INCLUDE STATE IN ADDRESS

GARAGEMENS' SPECIAL

erator Test Meters 35-0-35
meters 4¼in. dial 45/-. 0-10
meters 4¼in dial 45/-.

ding Resistors can be supplied
make volt meter read 0-10,
at 12/6 extra.

SPECIAL OFFERS

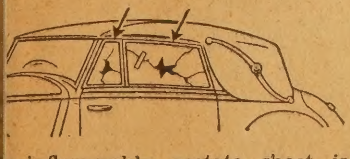
nner Sets, open end, SAE or
t. Special price, 5 spanners, **4/9.**
or Whit, open end Spanners. 6
nners to set. German made,
set. American Feeler Gauges,
English King Dick Ring Span-
s, 1 1/16in x 1 1/8in Ring Span-
, **35/-**, 1 1/16 x 1¼, **37/6.**

alemit Flexible hose-type
ase Guns. Suit all modern cars,
-. Parabolic Reflector Mirrors,
, **15/-**; 10½in, **39/6**. Build your-
a Spotlight or useful for photo-
phic work.

it. Tube Spanners. Sets 3 Span-
s and Bar, **11/9** set. 12in Steel
ers, single-side, **3/6.** 12in Steel
ers, double side, **4/6.** 6in Steel
ers, **2/6**, 2-foot Folding Steel
ers, **5/6.** 1-foot Folding Steel
ers, complete in leather carry-
pouch, **5/6.** English Headlamps,
ck and Chrome finish, 6 or 12
. Complete with Globes, **£6/15/-**
Whitworth Socket Sets, 6
kets and lever bar, **13/6** set.

itworth Spanner Sets open one
ring the other, **25/-** set, 6 span-
s to a set. English Hair Clip-
s, first-grade quality, **17/6** pr.
erican Boxwood Yard Sticks.
al for Tailors, Draughtsmen,
Brand new, **8/6.** 6 volt
dscreen wipers worth **£6/10/-**,
cial Price **£3/15/-**. Brand new
ny Steel Tow Ropes with looped
ls, **17/6.** Army Tripods. Many
s for photographic work, levels,
, 41in long, **22/6** each.

lace those broken side curtains
h cellulose acetate which takes
place of celluloid and lasts four
es longer. Will not discolor, 32/6
et.

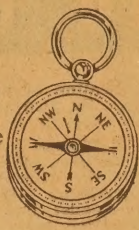


n-inflammable acetate sheet is
ommended for all types of side
tains. Sheets are 1.20 thousands
k. Size of sheet 24in. x 52in.
be sewn or cemented into
mes.

ENGLISH POCKET COMPASS

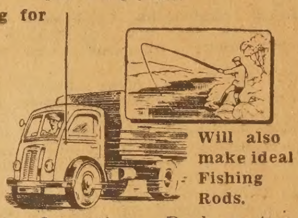
Brand New. Very accurate. No hiker should be without one.

6/9



STEEL ARMY TANK AERIAL RODS WILL MAKE IDEAL RADIO AERIALS FOR CAR OR TRUCKS.

Too long for postage, advise nearest railway station.



Base to suit Aerial. 9/6 EACH.

Will also make ideal Fishing Rods.

12ft long. 3 sections Each section 4ft, 22/6. 8ft long, 2 section, **15/-.**

Another Lucky Repurchase! American Elgin 8-day aircraft clocks.

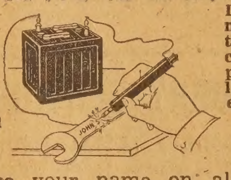
FIT ONE TO YOUR CAR OR TRUCK

£5/5/-

The name of Elgin is world renowned and made by the best manufacturers in America.

ELECTRIC ENGRAVER

What everybody has been waiting for. An Electric Engraver that works off your car battery.



Engraves anything in metal

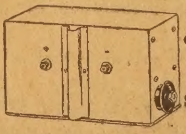
Ideal for name tags, dog collars, plant labels, etc.

29/6

Engrave your name on all your tools. Marked tools are never stolen. No Garage should be without one.

COMPLETE BATTERY CHARGER

Fitted with brand new English Selenium Rectifier.



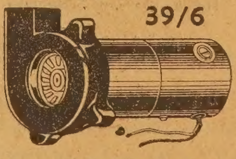
Work off 230v. AC Household Supply.

Charges any battery from 2 to 6 volts at 5 amps. £6/15/-, complete.

ENGLISH MOTOR AND BLOWER, 24 VOLTS

39/6

Will Work off 32-volt Lighting Plants.

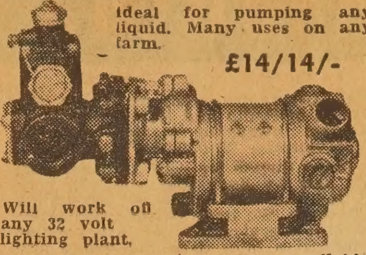


Larger size also available that will work off 12 or 24 volts. £3/15/-.

Lucky Repurchase! Aircraft 24 volt motor complete with 400 gal. per hour pump.

Ideal for pumping any liquid. Many uses on any farm.

£14/14/-



Will work off any 32 volt lighting plant.

Be Early! Limited quantity Available.

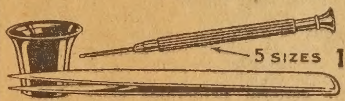
How is this for Value: GENUINE SWISS GENTS' WRISTLET WATCHES

Genuine Leather Wrist Strap, 79/6. Expanding Chrome Band. American Style, £4/4/-.

AMERICAN VACUUM or AIR PUMP

Builds up air pressure to 30lb at 1000 R.P.M. Develops up to 120lb of hydraulic pressure, will pump 7½ gallons S.A.E. oil or filter other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems .. £3/15/-.

WATCHMAKERS AND INSTRUMENT MAKERS



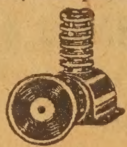
5 SIZES **14/9**

English Tweezers	**6/6 and 5/6**
English Pin Vises	**7/6**
Eyeglasses	**6/6 and 8/6**
Extra strong double lens Eyeglass	**15/-**
Small Screwdrivers, 2/6. Large,	**3/6**

BRAND NEW AIR COMPRESSOR

2.2 cubic feet, will pump up to 75lb

Never before at this price. Ideal for Spraying.

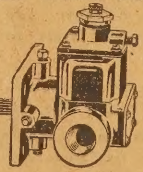


£11/15/-

Will work off ¼hp Motor.

AMERICAN FUEL PUMPS

USED BY THE R.A.F. STAINLESS STEEL VANES



WILL PUMP ANY LIQUID

400 galls per hour. In excellent order, 55/-. Brand new, 75/-.

ARMY FOCUSING TELESCOPE

Easily converted for use on dumpy levels.
Can be used as a rifle sight.
Excellent magnification. **£4/19/6**
(Fitted with cross hairs.)

ADJUSTABLE FOCUS

ANSWERS TO CORRESPONDENTS

R.F.C. (Dargaville, NZ) writes in appreciation of Radio and Hobbies and forwards two interesting service cases for the "Serviceman Who Tells."

A.: Many thanks for your kind remarks. R.F.C., and we hope that you will continue to find the magazine interesting and helpful. We have passed your letter on to the Serviceman for his possible comment at a later date and would also like to express our appreciation of the trouble you have taken to submit these cases.

J.McD. (Bowden, SA) sends us 12 months' subscription and makes some comments about Radio and Hobbies in general and the "Answer Tom" and "Learn While You Build It" articles in particular.

A.: Your subscription has been passed on the department concerned, J.McD., also your comments about the late arrival. We trust that this matter has been satisfactory adjusted by now. Very glad to hear that you find the two articles so interesting and you will, no doubt, be interested in the current "Teach Yourself Radio" series which has replaced the "Learn While You Build It." We were also glad to note your comments regarding the experiences of A.N. (Lamb Island, Qld.), and if there are any other readers who have had similar experiences, they may care to write to us.

J.S. (Minnipa, SA) writes to say how much he looks forward to Radio and Hobbies every month and to inquire whether we intend publishing any constructional details of DC mains-operated sets.

A.: Glad to hear that you find the magazine so enjoyable, J.S., but we are afraid we cannot do much to help in the matter of the DC sets. The demand for these is relatively small and this fact, coupled with the very real danger which they present to both the builder and user, has forced us to adopt the attitude that they are unsuitable projects to describe for the home constructor. Some articles giving the general principles were published in August and September, 1942, and the circuits illustrating these are available through our query service.

D.H. (Wairewa, Vic.) forwards his subscription renewal and asks about possible publication of details of a guitar amplifier. He also expresses appreciation for the contents of the magazine.

A.: Thanks for your subscription, D.H. It has been taken care of and you should have the official receipt from the subs. department. Details were published in the August, 1948, issue of a 9-watt Guitar Amplifier, together with the information on the pick-up head for attachment to the guitar. We are pleased to note your mention of the assistance obtained from the magazine and we hope that it will continue to appeal to you in that way.

D.C.M. (Balcombe, Vic.) says he built the "Carry Set" but was misled by incorrect socket pin numbering on the IR5.

A.: We must plead guilty to the charge and can only apologise for the inconvenience it caused you. The No. 3 and 6 should be interchanged. We always double and triple check our circuits but, in the inevitable hurry and bustle of getting things ready for press, little errors like this do slip through. Our only consolation lies in the fact that other magazines suffer likewise.

D.H. (Kawarren) forwards a circuit of a one-valve set, together with an impressive log of stations which he has received on it, and suggests that it may be of use for the "Reader Built It" page.

A.: Thanks for the circuit and log of stations, D.H., which is certainly good for such a simple set. We have passed the details on to the "Reader Built It" section for possible use at a later date.

A.C.R. (Bendigo, Vic.) writes to express his appreciation of Radio and Hobbies and particularly the new "Teach Yourself Radio" series.

A.: Many thanks, A.C.R., and we trust that you enjoy the rest of the beginners' series.

H.I. (Kalgoorlie, WA) encloses the circuit of a car radio receiver which he thinks may be of interest to readers.

A.: Many thanks for your interest, H.I., and we will keep your circuit in mind for the "Reader Built It" page.

J.M. (Ascot, Qld.) writes to suggest the idea of feeding the output from ordinary telephone circuits into amateur transmitters for the purposes of speeding t transmission of messages in the eve of floods and other emergencies.

A.: There would be no technical dif culty in doing what you suggest, J.M but it would not be a good idea for number of reasons. A telephone circ normally operates on a duplex syste that is, both parties can speak and heard at the same time. Most amate circuits work on a simplex system, whi means that a station may not transn and receive at the one time. Ev more important is the fact that rad broadcasts can be heard by as ma people as wish to listen in and al that other stations may be occupyi adjacent channels. This means that is necessary in most cases to have skilled operator on hand to put messag into the best form for transmission ov the air and also to adjust the equi ment for best performance. It is a matter of convenience and organis tion to suit any particular set of ci cumstances. Sufficient to say that it hardly ever done.

E.S. (Mossman, Qld.) asks about t operation of a BFO, since he and se eral Army companions have been arg ing about it for some time.

A.: Stop arguing, E.S. As far as w can see, you're all on the wrong trac Rather than try to explain it all in t space available, we'll hold it over f reference in the "Argument" columns.

C.D.S. (Glenbrook, NSW) forwards subscription to Radio and Hobbies ar thanks us for some data forwarded prev ously. He also details his reactions opening a kit of parts for the Kars not having indulged in the hobby sin the early 1930's.

A.: Thanks for your subscription, CD and this has been forwarded to the a propriate department. Yes, things ha changed a bit since the time you me tion and we can fully appreciate ho you felt. However, you seem to be a proaching the problems in a logical ma ner and, though it may take time, the is no reason why you should not com plete the project successfully. The quali of chassis is something which has wo ried us quite a lot and we can only ho that, if enough people complain, t makers concerned may see fit to im prove their product.

K.K. (Canberra, ACT) finds it conven ent to use the speaker in a battery por able receiver as an extension for the no mal household radio. The wires to t speaker are simply attached to the voi coil so that it is very easy to detac the portable and allow it to perform i normal function when required. A switc is included so that the extension speak can be switched off when it is n wanted. It was found unnecessary disconnect the speaker transformer the portable. Our correspondent poin out that using the portable in this wa saves the cost of the speaker and ca and at the same time the batter operated receiver is always availab in case of power failures.

A.: Many thanks for the suggestio K.K., and as you will note, we hav written a precis of your letter above.

A.H.P. (Bandiana, Malaya) inquir about the grid dip oscillator which w described in the April, 1950 issue Radio and Hobbies.

A.: The three additional connectio on the coil socket were provided s that the meter and batteries of the bas instrument could be used, should it b desired to make a special auxilary instru ment for VHF. As you observe, onl three of the connections are actually use in the basic instrument. Since describin the original instrument, we have use the instrument on frequencies as low 450 Kc and also constructed an auxiliar plug-in instrument which will operate frequencies up to about 180 Mc. Infor mation on the additions is availab through the 2/- query service.

(Continued on Page 104)

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required, must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 3/6. These are available for nearly all our designs.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

R. & H. TAPE RECORDER

(Continued from Page 71)

ıe HF oscillator operates at ap-
imately 60 Kc which is a good
re for this work. At this fre-
ıcy, which is far above the aud-
range, considerable radiation
take place, and be picked up by
amplifier input. If this pickup
nough to cause additional nega-
bias on any amplifier stage, par-
larly the first, distortion at all
low volume will occur, and the
itivity of the amplifier reduced.
erodyne interference at sub-mul-
es of the oscillator frequency can
take place.

or this reason, the oscillator is
ınted on the chassis as far from
input as possible, and a shield
ed around the coil. This is
ınd on a special core to increase
ciency and restrict the field, but
ertheless the shield is a good
g. It should not hug the coil too
ely otherwise it may reduce out-

TERNATIVE MOUNT

would probably be better to
ınt the coil above the chassis to
her isolate it, but we have not
nd this necessary. It makes wir-
a little more difficult, as several
nections must be run through the
ssis.

good test for oscillator leakage
to remove the oscillator valve
en listening to a signal in the re-
d position. There should be no
p in signal strength, or at most
ery tiny one.

he amount of oscillator voltage
lied to the head is quite import-
in achieving the lowest noise
el and best tape sensitivity. Un-
tunately the average constructor
ıot well equipped to measure such
ıgs.

here will be a condition at which
e sensitivity is highest, and also
e noise. When the bias is in-
ased beyond this figure, the noise
l decrease quite sharply, but sen-
vity only a little. In practice,
do best to ensure plenty of os-
ator bias, a condition which should
met with the circuit values given.
recording without bias—you will
shocked at the result!

ALL LEAKAGE

n our recorder, we checked the
ount of leakage on the oscilloscope
compared with the normal noise
el of the amplifier. The leakage
ıld only be seen as a small value
te comparable with the noise level
lf. This is probably about the
t one can expect.

ncidentally, one of the best
thods of restricting oscillator and
er fields from causing trouble is
completely enclose the bottom of
chassis with a metal plate. It's a
ıple matter, but sound practice.

Vhen recording from radio, it is
te possible that weak heterodynes
l be heard on some stations, due
interaction with the bias fre-
ency. In our case, these were only
significance on weak stations
ich we would not use; but there
't much to do about them except
change the oscillator frequency
htly. This could be achieved by
ding a small condenser value to
t already across the coil. Do not
rdo this, however, otherwise you
y affect the output. We mention
matter mainly so that you can
ognise it should it occur.

The power supply is mounted on a separate chassis, which is important if, as visualised, the whole equipment is housed in a single cabinet with the amplifier and power supply underneath the motor. The head is most susceptible to hum pickup on playback and the transformer radiates quite a field.

With a separate chassis, it can be mounted at a spot which, by experiment, is found to produce least hum. In addition, the transformer can be rotated on the chassis before bolting down by leaving the leads a little long, in case an awkward angle is called for on the part of the power supply.

There is not much which can be done about hum pickup from the motor, although this is generally not serious at the normal working levels. Also the motor can be mounted in such a position as to cause least pickup.

Several transformer manufacturers have agreed to produce special transformers for this job having a low radiation field. This is accomplished by using designs with a low flux density, and by using other shielding methods which are quite effective.

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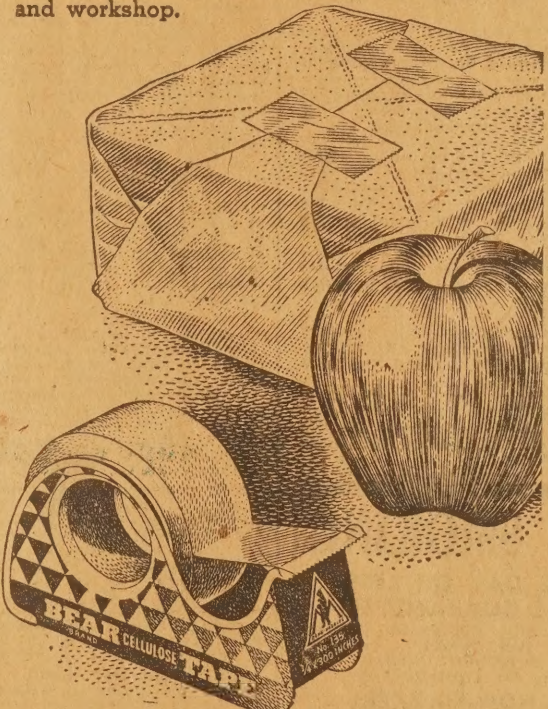

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T82/1

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FOR SALE. 20 watt amplifier push-pull 807s. Complete with control unit. £29/10/-, as new. **T. Stephenson, Coota Rd., Temora. Phone 318.**

FOR SALE. Williamson amplifier, £20. Garrard auto. changer RC70, £10. Both perfect. Any trial. **XL3373.**

FOR SALE. Recording unit, 2 BRS, two speed tables, ribbon mike, stand, amplifier, 3 6J7 807 in two leatherette cabinets. Complete or in units. **Heggie, 83 Rochester St., Homebush.**

FOR SALE. Large quantity of radio parts including test equipment, valves, etc. **161 Flood St., Leichhardt. LM6141.**

SELL: Philips No. 4 Rcvr. 1-20 Mc/s 4 band 240 V.A.C. or 6 V.D.C. Valves used VR65, 6J8, EBF35, 6J8, EL3, 6x5. 8in Spkr and 6v Accumulator, £25. MN26C 8 Valve Rcvr. Controls Vol. Tone RF Gain. BFO Tuning Meter. 240 V.A.C. Power Supply. Speaker and 4 Valve, 3 brand, 10 to 80 Meter. Gen. Coverage and Band Spread. Converter, £30. No. 19 Transciever. 8 valves, 240 V.A.C. Power Supply and Speaker for Rcvr. Section £15. No. 22 transceiver. No Tubes or Power Supply. FS6 Rcvr. only Tubes and H.T. Supply. Other Rcvrs and lot of equipment.—No Freight Paid—Evenings after 8. **Pearce. 55 Railway Pde, Lakemba, N.S.W.**

SELL. Hammarlund super-pro SP.200X, complete. £120. or offer. **Ph. XY6275.**

SELL. 3 valver, 2 IT4s, 13S4, with batts., £9 or offer. **M. Rollins, 16 Marns St., Wagga.**

SELL. Old copies Radio & Hobbies. **Buchester, Mametz St., Yeerongpilly, Q.**

WANTED TO BUY circuit diagram for No. 19 mark 2 transceiver. **K. Branch, Derby Rd., Maryborough Vic.**

WANTED. 3 only, 109 vibrators. Ring **JA4778, 8.0 a.m., 4.0 p.m.**

WANTED. Copy of "Radio For The Millions," price & particulars. **J. H. Zwar, Murray Town, Sth. Aust.**

WANTED. Bendix frequency meter. Pay £40-£45. **G. Hodgson, 10 Ormonde Parade, Hurstville.**

WANTED. Communications receiver. Must have 2 RF stages. Also BC221 freq. meter. **W. Field, 53 Bull St., Newcastle, 2N.**

WANTED TO SELL. 150 Radio & Hobbies, 1940 to 1952. 39 Radio World's. 15 Radio Science. **14 Elmie St., Hawthorn, Melbourne. WA1467.**

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A READER BUILT IT!

(Continued from Page 89)

terference on the broadcast band unless it is effectively shielded. Locating the unit within the steel case of a CRO will probably be sufficiently effective.

There should not normally be any trouble with RF interference with the CRT itself or its circuitry. If it is encountered, the step-up transformer or the complete unit could be placed in a shield box. In the latter case, provide plenty of ventilation for the 6V6GT.

There is nothing critical about the construction except that the leads to the high voltage points should be well insulated and kept clear of components and any metal to prevent loss of output from corona discharges. Be very careful with th
high voltage—it can hurt.

The high voltage filter capacito
are available on the market and,
quite a few cases, through Di
posals. A couple of .01 mfd 100
volt working mica capacitors cou
be wired in series to make up o
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ANSWERS TO CORRESPONDENTS

(Continued from Page 102)

R.W.G. (Morisset, NSW) has a commercial radiogram which, he claims, produces "static" on high notes when used to play records. He wants to know if we can help in advising on its repair.

A: Sorry, R.W.G., but it is virtually impossible to diagnose such a fault from the description you are able to give of the symptoms. We tip, however, that the trouble is due to distortion arising from records and pick-up being amplified. It gives a buzzing effect. The tone control should help to reduce it. We can only suggest that you enlist the aid of a competent local serviceman or return the set to the makers for test.

M. McI. (Willaura, Vic.) wants constructional details of an 8mm projector.

A: Sorry W. McI., but we have not published anything along these lines and so are unable to help you. In any case we do not think that such a unit would be suitable for home construction, requiring a degree of precision construction which is only found in well equipped machine-shops.

C.G. (Essendon, Vic.) wants to know if we would be interested in details of an intercommunication system which he describes and which appears to offer some advantages over current types.

A: From your brief description it would appear that the system may be of interest to other readers and we suggest you may care to submit fuller details for possible publication in the "Reader Built It" section.

N.B. (Cottesloe, WA) would like to be made fully aware of the meanings of the abbreviations "AM,PM,FM."

A: Yes, N.B., you are correct in assuming that they refer to some forms of radio transmission. In general, the ordinary domestic receiver will respond to AM only. This is the form of modulation employed by the stations on our broadcast band. We are holding your letter on the "Here's Your Answer, Tom" file with a view to covering the matter more fully.

V.H. (Kangaroo Point, Q'ld.) has a commercial radiogram with twin speakers. He wants to know if results would be improved if he were to take the speake
out and install them in a separate cabine

A: Not knowing anything about th
present cabinet we are not in a positio
to comment. However, it is not like
that any improvement will result unle
you follow an approved design to su
your speakers, such as a vented enclosur

L.R. (Collie, WA) tells about a simp
testing unit he has made. It is along th
lines of that featured in the Augu
issue of Radio and Hobbies.

A: Thanks for your interest, but as w
have already published the idea, we can
not make any use of your circuit.

B.C.J. (Lower Mitcham, SA) writes t
say that he now has the Radio an
Hobbies "Babygram" in operation an
that it is performing splendidly. H
notices that the spiral filament of th
6X4 is protruding farther from th
cathode after some operation than it wa
originally.

A: Yes, B.C.J., we were very please
with the little set ourselves. We do no
think that there is any need for you t
worry about the valve as long as it
working satisfactorily. Without having
look at the valve we would not like t
hazard a guess at the reason for th
displaced filament. In any case there i
nothing you can do about it except bu
a new valve.

C.S.F. (Fairfield, NSW) sends in th
circuits of a couple of amplifiers fo
comment.

A: Some of your ideas on amplifie
design are very much astray, C.S.F., an
it would take too long to explain why i
these columns. Possibly we will be abl
to deal with the subject in the "Answe
Tom" feature before too long.

M.K. (Callide, Q'ld) sends a circuit o
a metal locator and wants to know wha
valve types, in the miniature range
would be suitable for it.

A: It is probable that the types are no
particularly critical and we would sug
gest that the IT4 triode connected woul
probably work in all sockets, though i
might be better to use a 3S4 or 3V4 triod
connected for the last valve.

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